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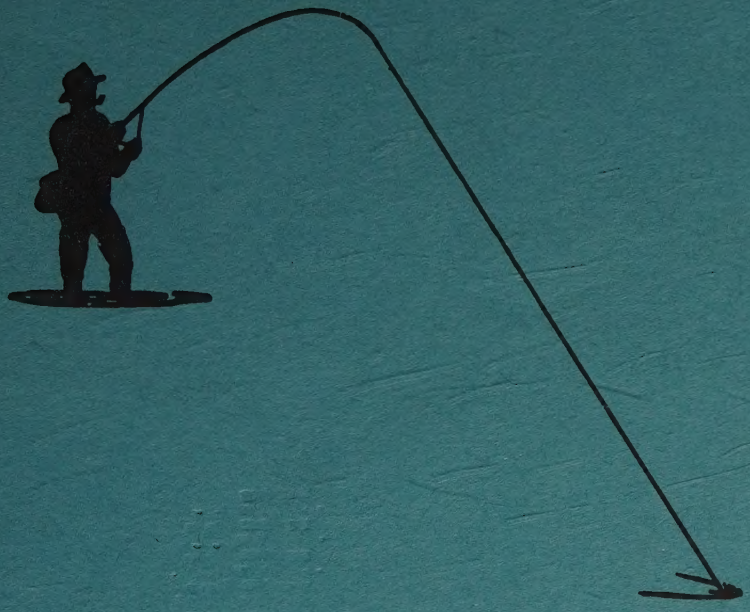
Sport Fishery Abstracts



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Sport Fishery Abstracts

An abstracting service for fishery research and management

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Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of papers on limnology, ecology, natural history and other fields of specialization will be included when the subject has application to the conservation of sport fish and the restoration of sport fishing.

Initials following an abstract are those of abstractors whose names are listed on page 54. Those abstracts without a source indicated were prepared by the Editorial staff. One volume consisting of not more than four numbers will be issued each year. Each number contains separate Author and Subject indexes, with the final number of each volume containing cumulative indexes.

The last number of each volume contains a list of publications screened for appropriate material. Suggestions for improving the usefulness and coverage of Sport Fishery Abstracts are solicited.

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Prepared in the Branch of Federal Aid
Raymond E. Johnson, Chief
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Geneva T. Thompson, Asst. Editor

1295. Volf, F. and J. Havelka. 1957. TLUMENI INFEKCNI VODNATELNOSTI ANTIBIOTIKY V RYBARSTVI (Suppression of Infectious Dropsy by Using Antibiotics in Fisheries). Sbornik Ceskoslovenske Akadamie Zemedelskych Ved, Rocnik 2 (XXX), Cislo 5, pp. 349-360.

From the survey it is evident that the effect of the antibiotics depends on the type of bacteria causing, and helping to cause, infectious dropsy. All three antibiotics which were investigated--streptomycin, chloramphenicol, aureomycin--were much more effective with fish from which a pure culture of Pseudomonas punctata ascitae was obtained. In this respect streptomycin and chloramphenicol proved best, while worse results were obtained with aureomycin, although this had the greatest effect against the bacteria Pseudomonas punctata when tested in vitro. If there was a mixed infection, i.e. if Pseudomonas punctata ascitae was accompanied by Pseudomonas fluorescens liquefaciens, the most effective was streptomycin, which also corresponds to the results obtained in tests in vitro, in which streptomycin had the greatest effect on Pseudomonas flourescens liquefaciens.

It is clear that for a proper indication of the antibiotic to use, thorough bacteriological investigation--on at least twenty fish--must be carried out before carp are treated. Further tests must be carried out with various combinations of antibiotics, the properties of which supplement each other and increase the combative effect on the bacteria of infectious dropsy, particularly when there is mixed infection.

On the whole the most stable effect was provided by streptomycin. Next in order came chloramphenicol and the least effective in field experiments was aureomycin. There is no mention in technical literature of its use to suppress infectious dropsy. The results of our field experiments in treating diseased fish with aureomycin do not correspond to the figures for its effectiveness obtained in vitro. This finding can be explained by the difficulty in dissolving this antibiotic and its unequal distribution in the organism, with the resulting lower effect. Therefore, we cannot recommend for the time being the use of aureomycin for internal treatment. Its application into the digestive apparatus is more effective, for there it comes more easily into direct contact with the entire digestive tract and with its contents, thus giving fuller effect to its certain and proved bacteriological effect. Our assumptions are confirmed by the results in human medicine. (From auth. summ.)

1296. Wolf, Kenneth E. THE CAUSE AND CONTROL OF BLUE-SAC DISEASE. Ph. D. thesis, Utah State Agr. Coll. 104 p. 1956.

Blue-sac disease is an edematous condition that is probably the most common disease of fishes in the yolk sac stage. It is characterized by an abnormal accumulation of fluid overlaying at times only part of the yolk sac but frequently enveloping it. The pericardium is at times similarly affected. The fluid usually contains blood elements and has protein in it. Anemia, hemorrhage and petechiae often accompany the disease and there is usually circulatory system dilation and breakdown. The yolk itself is often denatured and fat droplets within the yolk often coalesce.

The results of this study indicate that the cause of the disease is biochemical. Although the inherent water chemistry is not involved, blue-sac disease can be experimentally evoked by incubating eggs in a closed system. Other factors being equal, the longer the eggs are incubated, the greater will be the resulting incidence of blue-sac disease. This indicates that the disease is due to an accumulation of metabolic wastes.

It is concluded that an ineffective flow of water whereby toxic accumulations are permitted to occur is the prime cause of the disease in hatcheries. The control of the disease, therefore, lies in its prevention. - Jessop B. Low.

1297. Clark, William J. AN EVALUATION OF METHODS OF CONCENTRATING AND COUNTING THE PHYTOPLANKTON OF BEAR LAKE, UTAH-IDAHO. M. S. thesis, Utah State Agr. Coll. 51 p. 1956.

A haemacytometer was found to be an adequate counting chamber for phytoplankton. It was determined that if at least 100 organisms were counted there was little error. Filtration through a membrane filter with pores .5 to 1.2u was found to be an effective method of concentration. For speed and efficiency the membrane filter concentration was most desirable. - Jessop B. Low.

1298. Bulkley, Ross Vivian. THE USE OF BRANCHIOSTEGAL RAYS TO DETERMINE AGE OF LAKE TROUT SALVELINUS NAMAYCUSH WALBAUM. M. S. thesis, Utah State Agr. Coll. 32 p. 1957.

From a study of 342 lake trout it was concluded that the branchiostegal-ray method is accurate for age determination. Some known-age fish were used to verify the ages assigned from ray reading. Fish Lake trout mature between $4\frac{1}{2}$ and $6\frac{1}{2}$ years of age. - Jessop B. Low.

1299. Royce, William F. 1957. Statistical Comparisons of Morphological Data. Biometrics 13(4): page 546.

The methods of statistical comparison of morphological data are examined with special regard to techniques suitable for racial studies of tunas. Comparison of samples by means of a test of significance is discarded because it leads to a trivial conclusion. In its place is suggested and defined a measure of overlap of frequency distributions.

The computation of overlap for single counted characters is extended to single measured characters through the use of regression analysis and to multiple characters either counted or measured or both.

The general concept of overlap is related to the proportion of one sample which might belong to another specified sample of equal size. This is considered to be a maximum for any intermingling which might have occurred. It is pointed out that such a maximim is useful when considered in conjunction with tagging returns. (Auth. abst.)

1300. Howell, Henry H. 1957. A TAXONOMIC AND DISTRIBUTIONAL STUDY OF THE GENUS NOTROPIS IN ALABAMA. Ph. D. dissertation, Department of Biology, University of Alabama. 288 pp.

Several thousand specimens of Notropis collected from 452 stations throughout the State of Alabama were critically examined. Thirty-three species of the genus are known to occur in the state. They were found in 19 different drainage systems in five physiographic provinces. Each major river system usually contained from 11 to 12 species, with the Warrior River System containing 14. In the entire Mobile River Basin, which drains about three-fifths of the state, there were 23 species, eight of which were endemics.

A diagnosis of each species is included along with keys to their identification. (H. T. B.)

1301. Boschung, Herbert T. 1957. THE FISHES OF MOBILE BAY AND THE GULF COAST OF ALABAMA. Ph. D. dissertation, Department of Biology, University of Alabama. 626 pp.

This research involved a survey of the fishes of Mobile Bay and the coastal waters of Alabama and represents the first study of this kind in the area. The dissertation includes complete descriptions of each species collected, along with keys to their identification, notes on their ecology, and a comprehensive bibliography pertaining to the Gulf coast. The specimens which formed the basis for the study were collected between 1950 and 1956, and are deposited in the collections of the University of Alabama. Shrimp trawls, seines, dip nets, hook and line, and rotenone were used in obtaining specimens. This study has resulted in a list of 156 species definitely recorded from Alabama waters. (From auth. abst.)

1302. Vallentyne, J. R. 1957. PRINCIPLES OF MODERN LIMNOLOGY. American Scientist, Vol. 45, No. 3, June, pp. 218-244.

This article is brief but nonetheless quite comprehensive discourse on limnology covering the physical attributes of water, thermal stratification and mixing principles, light absorption, etc., and the processes involved in the metabolic transformation of energy. Four areas which would repay critical study are suggested: (i) development of quantitative techniques and theory for study of turbulent transfer processes in the lake and between the lake and its surroundings; (ii) an understanding of the dynamics of phytoplankton growth on a molecular level; (iii) limnological application of Riley's quantitative approach to the dynamics of marine plankton; (iv) extension and development of absolute dating methods as applied to lake sediments.

1303. Eschmeyer, Paul H. 1957. THE LAKE TROUT. U. S. Fish and Wildlife Service, Fishery Leaflet 441, Aug., pp. 1-11.

Different aspects of the life history of the lake trout, its geographic distribution, artificial propagation, and Great Lakes fisheries are presented. The relation of the sea lamprey to the commercial fisheries of Lakes Huron, Superior, and Michigan is also covered.

1304. Tucker, Allan. 1957. THE RELATION OF PHYTOPLANKTON PERIODICITY TO THE NATURE OF THE PHYSICO-CHEMICAL ENVIRONMENT WITH SPECIAL REFERENCE TO PHOSPHORUS. The American Midland Naturalist, Vol. 57, No. 2, April, pp. 300-370.

This investigation was undertaken to discover relationships which may exist between the seasonal and vertical distribution of phytoplankton and changes in physico-chemical conditions in five Michigan Lakes. Morphometric data are presented for each of the lakes. The four lakes in northern Michigan are only a few miles from each other, nevertheless, they differ markedly in their morphometric, physico-chemical and biological conditions. The various fractions of phosphorus, soluble inorganic, soluble organic, organic sestonic and acid soluble sestonic, are discussed. Methods for their determination and calculation are outlined.

There is no evidence in this study that phosphorus liberated from the mud and brought to surface waters during an overturn has any controlling influence over the reproductive rate of the phytoplankters probably because there is always a sufficient minimum present. It is suggested that other nutrient elements which are combined with the ferric complexes and released at approximately the same time of the year as phosphorus, are responsible for the phytoplankton pulses occurring after each overturn. The magnitude and duration of each of the phytoplankton pulses which occurs after an overturn may depend upon the magnitude and duration of nutrient liberation from the mud, which in turn depends upon how soon before the overturn the bottom becomes depleted of oxygen.

In shallow unprotected lakes which are undergoing almost constant circulation, there would probably always be an adequate supply of nutrients available to the plankton. Factors other than nutrients may control the formation of plankton pulses in these lakes. It is suggested that these factors do not stimulate the organisms to greater production but rather inhibit the production already in operation. These inhibitory factors might be the cause of the troughs in seasonal variation of phytoplankton populations in this type of lake. (From auth. summ.)

1305. Sublette, James E. 1957. THE ECOLOGY OF THE MACROSCOPIC BOTTOM FAUNA IN LAKE TEXOMA (DENISON RESERVOIR), OKLAHOMA AND TEXAS. The American Midland Naturalist, Vol. 57, No. 2, Apr., pp. 371-402.

The results of a fifteen months study on Lake Texoma, Oklahoma and Texas, are presented. Emphasis has been placed on the horizontal distribution and seasonal changes of the benthic invertebrates.

It was found that the waters circulate almost continuously throughout the year, with some tendency for stratification to occur, at least in areas that have some protection from the prevailing winds. This tendency is reflected to some extent in the composition and distribution of the bottom fauna, at least in the profundal area. A total of eighty-seven species (or groups) of macroscopic benthic inver-

tebrates was collected. Of this number, the insects predominated with seventy species. Brief autecological notes are presented for each species or group. The distribution of the bottom fauna was found to follow closely the character of the substratum with each principal substratum type showing both qualitative and quantitative differences. The substratum type in turn was dependent upon the nature of the original lake basin as modified by certain environmental factors, notably depth and wave action.

Data are presented to demonstrate the presence of ecotones. Those between adjacent cenoses are rather poorly defined, but those between the littoral and profundal systases are well defined. This latter ecotone is considered to be the equivalent of the sublittoral zone. The annual standing crop of bottom fauna from two cenoses is given. The minimum standing crop was found in the late summer and the maximum in late winter and early spring. It is suggested that although this production figure is low, the lake is probably more productive in the next trophic level (fish) due to certain of the modifying factors that would be expected from the amount of benthos produced. (From auth. summ.)

1306. Jones, F. R. Harden. 1957. ROTATION EXPERIMENTS WITH BLIND GOLDFISH. The Journal of Experimental Biology, Vol. 34, No. 2, June, pp. 259, 274-5.

Fish can maintain their orientation when rotated at constant velocity on a turntable in the absence of a moving visual field and when there is no relative motion between the water and the sides of the tank in which they are swimming. The response is not affected if the lateral lines are cut, and it seems most likely that the stimulus to which the fish reacts is labyrinthine in origin. The semicircular canals have been suggested as the sensory channels through which a fish detects a rotation at constant velocity, and if this is so the mechanical stimulus must be an angular acceleration. But it has not been shown how a fish can be subjected to an angular acceleration during rotation at constant velocity, neither is there any experimental evidence to rule out the possibility that the centrifugal force developed during rotation, which would be detected by the otoliths, is the stimulus to which the fish responds. The behavior of blind goldfish on the turntable was therefore re-examined.

The experimental work was carried out over a period of 18 months with six goldfish, 4-6 cm. in length, which were blinded by removal of their eyes while under anaesthesia. All survived the operation and subsequently grew faster and appeared to be in slightly better condition than the stock of normal fish from which they were taken.

Blind goldfish react to rotation at constant angular velocity by swimming against the direction of rotation so as to maintain, on the whole, the same orientation or bearing relative to earth. The lowest angular velocity to which the fish appear to react is below 10°/sec. For the best performers the threshold is about 3°/sec. The stimulus to which the fish responds is not one of contact, initial swirl or water current (when the turntable gets under way), variation in turntable velocity or centrifugal force. The semicircular canals are probably the sensory channels through which a fish is able to detect rotation at constant velocity and the mechanical stimulus to which it responds is probably an angular acceleration. How the fish becomes aware of angular accelerations during rotation at constant velocity is not yet understood.

1307. Hardisty, M. W. 1957. OSMOTIC CONDITIONS DURING THE EMBRYONIC AND EARLY LARVAL LIFE OF THE BROOK LAMPREY (Lampetra Planeri), The Journal of Experimental Biology, Vol. 34, No. 2, June, pp. 237-252.

Observations have been made on the swelling of eggs in tap and distilled water. The rate of uptake of water through the outer membranes and the surface of the ovum fell off sharply within a short time of contact with water. In distilled water uptake into the perivitelline space was very much greater than in tap water, but there were no significant differences in the volume of the ovum itself in these two media. The outer egg membranes are apparently freely permeable to water and ions, and the mean Cl concentration of the perivitelline fluid in the later stages of development was found to be only 2.4 mM/L.

Evidence is presented which points to a decrease in the volume of the embryo at some point between gastrulation and hatching. In tap water a contraction of the whole egg was observed from the fifth day onwards. The water content of the embryo at hatching was not very much greater than that of the ovarian egg. After hatching, until the absorption of the yolk, there was a continuous increase in the fresh weight and water content of the ammocoetes.

The evidence suggests that the ovarian egg is in osmotic equilibrium with the peritoneal fluid (mean 110 mM/NaCl/l). During development the osmolar concentration of the total egg fluid was reduced to values similar to those calculated from the known dilution, i.e. 30-40 mM/l. At hatching, the osmolar concentration of the embryo (80 mM/l) was raised within a few days to 11-120 mM/l.

The observed reduction in Cl concentration of the whole egg was much greater than that calculated from the increases in volume. The Cl concentration of the embryo itself was reduced from an initial value of 56 to 15 mM/l. embryo fluid a week before hatching.

Determination of the total Cl content of whole eggs and embryos showed very marked loss of Cl ions in the two days following fertilization. Within 35 days after hatching the Cl level had been raised by active uptake to about four times the values at the time of hatching. (From. auth. summ.)

1308. Hubbs, Clark. 1957. DURATION OF SPERM VIABILITY AS A FACTOR IN FREQUENCY OF FISH HYBRIDIZATION. The Texas Journal of Science, Vol. IX, No. 4, Dec., pp. 472-474.

The experiments reported on here concern the effect of sperm viability on natural hybrid frequency. The more primitive logperch, Percina caprodes, and the more specialized orangethroat darter, Etheostoma spectabile, were used. Although data are not conclusive, longer retention of function of logperch sperm is strongly

indicated. This would account in part for the greater frequency of natural hybrids between the more primitive than the more specialized species. Three possible causes now have been shown to influence the incidence of natural hybrids in darters: reproductive behavior, control of female over egg deposition, and duration of sperm viability. Degree of relationship between species may, therefore, control hybridization frequency to a lesser degree than the more or less accidental factors listed.

1309. Forney, John L. 1957. BAIT FISH PRODUCTION IN NEW YORK PONDS. New York Fish and Game Journal, Vol. 4, No. 2, July, pp. 150-194.

Bait fish were stocked in 95 farm ponds in central New York State during the years 1953 to 1955. Six species were tested individually in one or more ponds. Three, the golden shiner, white sucker, and fathead minnow, were found to be suitable for propagation in New York ponds.

Adult golden shiners were stocked at rates of 200 to 1,800 per acre. Population estimates during the second growing season demonstrated that the number of golden shiners present was governed more by physical and biological environment than by stocking rate. The weight of the standing crop at the end of the first growing season averaged 167 pounds per acre compared with 362 pounds per acre in August of the second growing season. The average yield from fertilized ponds in the second growing season was nearly 20,000 shiners over 3 inches long.

Suckers were stocked as advanced fry in 18 ponds at rates of 50,000 to 231,000 per acre. Survival of fry to fall ranged from 2 to 71 per cent and averaged 24 per cent. Growth rate in fertilized ponds was negatively correlated with population density. Yield during the first growing season averaged 285 pounds per acre including that for three ponds stocked with eyed eggs. In seven ponds where young were overwintered, their mean length increased 0.72 inch and the increment in population weight was 92 pounds per acre from fall to the following May.

Adult fathead minnows were stocked in eight fertilized ponds at rates of 600 to 2,000 per acre. A relatively small proportion of the first year's hatch of young reached salable size of 1.8 inches by fall, and the average yield from the eight ponds was 12,140 per acre. Seven ponds managed for a 2-year period yielded an average of roughly 50,000 minnows of salable size per acre. (Auth. abst.)

1310. Forney, John L. 1957. CHEMICAL CHARACTERISTICS OF NEW YORK FARM PONDS. New York Fish and Game Journal, Vol. 4, No. 2, July, pp. 203-212.

Data on temperature, oxygen, pH alkalinity, total dissolved solids, phosphorous, and nitrogen content were obtained in 48 central New York farm ponds. These ponds exhibited considerable chemical diversity, with total alkalinity concentrations varying from 5 to 226 p.p.m. Solute concentrations of individual ponds fluctuated within broad limits in response to the inflow of runoff and biological activity within the pond. (Auth. abst.)

1311. Hartman, Wilbur L. 1958. THE USE OF SEDATIVES TO REDUCE MANIPULATIVE ERROR IN MEASURING FISH. New York Fish and Game Journal, Vol. 5, No. 1, January, pp. 1-8.

Repeated fork and total length measurements were taken on sample lots of five fish each from four different groups of living fish. The fish were then drugged with urethane and the measurements repeated. The following information was obtained. (1) Although reductions in manipulative error were found statistically significant in half the comparisons, an analysis of the sample sizes of drugged and of normal fish that would be required to give the same accuracy demonstrated that even the significant reductions would be of little practical value. (2) Measurements of drugged fish were not significantly longer than those of normal fish for either fork or total lengths, and fork and total length measurements were found essentially equal in accuracy. (3) Under the conditions of this study, anesthetization did not appreciably shorten the time required to measure fish.

1312. Loeb, Howard A. 1958. COMPARISON OF ESTIMATES OF FISH POPULATIONS IN LAKES. New York Fish and Game Journal, Vol. 5, No. 1, January, pp. 66-76.

Population studies involving a number of fish species, but carp primarily, were carried out in three lakes ranging from 30 to 800 acres in size. Different sampling techniques were used and the data were analyzed by both the Schnabel method and direct proportion.

In 30-acre East Masonville Lake, sampling was done by electric shocking and an estimate of the fish population was calculated by the Schnabel method. Following this, the lake was treated with rotenone and the fish population was estimated by direct proportion based on the number of marked fish in sample collections. The total population was also determined by tallying the aggregate number of dead fish collected. Estimates by direct proportion agreed closely with the total of dead fish collected, but those by the Schnabel method fell far short. This phase of the work also demonstrated the relative efficiency of night shocking for fish collecting, the superiority of rotenone as a relatively non-selective tool, and the need for a waiting period of more than 3 weeks between marking and recapture to allow for proper redistribution of the marked fish.

In 800-acre Waneta Lake, electric shocking was used to capture carp which were then marked and released. After an interval of 40 days, sampling was done both by electric shocking and by seining. Population estimates by direct proportion were considered to be reasonably accurate using the data from either method of sampling.

Comparison is made with estimates by the Schnabel method based on approximately 23,000 and 13,000 fish of all species marked in Lamoka and Waneta Lakes, respectively. Trap nets were used exclusively in this work. Sampling by this method proved not sufficiently random, and results were considered unreliable.

It is concluded that estimation by direct propor-

tion, based on a relatively small number of marked fish, random sampling, and a substantial interval between marking and sampling, will give sufficiently accurate results for many practical purposes. (Auth. abst.)

1313. Strand, Fleur L. 1958. EFFECT OF HIGH CARBOHYDRATE DIET AND EPINEPHRINE IN SALMON AND BROOK TROUT. New York Fish and Game Journal, Vol. 5, No. 1, January, pp. 84-93

A study of growth rates and tissue glycogen deposition in salmon maintained on a high carbohydrate diet reveals that the fish grew more rapidly on this experimental diet than on the high protein control diet, but that there was a corresponding increase in stored liver glycogen. The simultaneous addition of epinephrine to the food just prior to feeding further accelerated the gain in total body weight for the fish on the high carbohydrate diet and also restored to normal the values of hepatic glycogen. Although fish on this experimental diet had less muscle glycogen than the control fish, the addition of epinephrine did not affect these levels markedly. Epinephrine injections in large trout accelerated maturation of the gonads. It is suggested that it might be profitable in terms of both rate of weight increase and economy to increase the proportion of carbohydrate in the diet of hatchery salmon, provided that epinephrine was administered simultaneously. (Auth. abst.)

1314. Peckham, Richard S. and Clarence F. Dineen. 1957. ECOLOGY OF THE CENTRAL MUDMINNOW, UMBRA LIMI (KIRTLAND). The American Midland Naturalist, Vol. 58, No. 1, July, pp. 222-231.

The mudminnow of Judy Creek, St. Joseph County, Indiana, inhabits the margins of the stream where the vegetation is dense. There is no evidence of hibernation. In winter the fish remain active among the vegetation under the ice and a higher percent of the stomachs contain food than any other season. Migration of the population is limited to lateral movements from the main stream into flooded areas following heavy rains. The breeding season is correlated with flooding of adjacent areas. The rise in the temperature of the water and the forming of suitable breeding habitats act as stimuli for spawning. Spawning occurs in April in the shallow pools of the flooded areas, which give excellent protection to the adults and the developing young. The number of eggs per female range from 220 to 1489.

Sexual dimorphism occurs in the central mudminnow in the form of a longer and a bluish-green coloration of the anal fin in the males. Also, the pelvic fin is colored in the larger males during the breeding season.

Common parasites include Clinostomum complanatum, Gyrodactylus limi, and Phyllodistomum brevicecum.

In Judy Creek the central mudminnow is a carnivorous, bottom feeder. Chironomids, copepods, ostracods, and cladocerans are the principal food items of the young of the year. Small crustaceans are less important to the adults. In addition to the chironomids, mayflies, caddis flies, and mollusks are the chief foods. A few fish are eaten by the mudminnow. Plant material appeared to be accidental in the diet. (Auth. summ.)

1315. Woods, Loren P. and Robert F. Inger. 1957. THE CAVE, SPRING, AND SWAMP FISHES OF THE FAMILY AMBLYOPSIDAE OF CENTRAL AND EASTERN UNITED STATES. The American Midland Naturalist, Vol. 58, No. 1, July, pp. 232-256.

The five recognized species of amblyopsids are grouped into three genera on the basis of the pectoral girdle, scleral cartilages, and presence of eyes in adults.

The epipleurals of amblyopsids are attached to the ribs lateral to the rib attachments, an arrangement held in common with the cyprinodonts and distinguishing both from the Haplomi. Differences between these two groups are sufficient to recognize each as a distinct suborder of the Microcyprini.

The strong development of sensory papillae, the imbedding of the scales, the jugular vent, and the fusion of the gill membranes to the isthmus represent specializations of the amblyopsids from the basal microcyprinoid stock.

The amblyopsids, except for one species, are distributed in the limestone region of the central United States between the Appalachian Mountains and the Great Plains, south of the limit of glaciation and north of the Cretaceous Mississippi embayment. Chologaster cornutus is found in the Atlantic Coastal Plain from Virginia to central Georgia.

The cavernicolous Amblyopsis and Typhlichthys apparently disperse through suberrranean channels below the water table. Chologaster, at least the species cornutus, is probably able to migrate through sluggish surface streams. (Auth. summ.)

1316. Fromm, Paul O. and Robert H. Schiffman. 1958. TOXIC ACTION OF HEXAVALENT CHROMIUM ON LARGEMOUTH BASS. The Journal of Wildlife Management, Vol. 22, No. 1, January, pp. 40-44.

The median tolerance limit of hexavalent chromium to Micropterus salmoides was found to be 195 mg. Cr/l. Marked sloughing of mucus from the anus of fish exposed to chromium was noted along with increased coughing movements. After $2\frac{1}{2}$ hours exposure to 94 mg. Cr/l. there was a slight increase in the oxygen consumption of the fish followed by a gradual decline to 27 per cent below normal after 68 hours exposure. No change in the histology of gill tissue was noted but extensive pathological changes in intestinal tissue was found. (R. H. S.)

1317. Harrington, Robert W., Jr. and William L. Bidlingmayer. 1958. EFFECTS OF DIELDRIN ON FISHES AND INVERTEBRATES OF A SALT MARSH. The Journal of Wildlife Management, Vol. 22, No. 1, January, pp. 76-82.

Two thousand acres of Florida east-coast tidal marsh, traversed by 354,000 linear feet of ditches, were treated with dieldrin pellets that were air-

disseminated at one pound per acre, to destroy sandfly (Culicoides) larvae.

The fish kill was substantially complete. The minimum immediate over-all kill throughout the marshes, exclusive of the Indian River shore line, computed by extrapolation of the kill data on an 1,100-foot and a 200-foot ditch segment, respectively, was 20-30 tons of fishes, or about 1,175,000 fishes, of at least 30 species.

Mollusks (snails, nudibranchs, tethyoids, and oysters) seemed to be unharmed by dieldrin. Crustaceans were virtually exterminated throughout the area. The entire aquatic crab population was apparently destroyed, and the fiddler crabs, all but annihilated, survived temporarily only in patches of marsh evidently missed by the pellets.

The larger game and food fishes succumbed most rapidly, larvivorous fishes next, and gobioid fishes last. Crabs set upon and destroyed the moribund fishes, but next day were dead themselves. Snails continued to devour fish carcasses. After two weeks, no trace remained of the litter of dead fishes.

A biweekly posttreatment fish census was taken along a 5,600-foot ditch traversing the marsh; enumerations and estimates of the numbers of each species encountered were supplemented by sampling collections. The census was abandoned when progress in repopulation ended its dependability. Repopulation by fishes began slowly about 4 weeks after the kill, was undeniable at 6 weeks, considerable by 8, and climactic at 10. It was initiated by the broad killifish (Cyprinodon v. variegatus), the dominant invader, and included record minimum-sized tarpon by the seventeenth week, but large-sized fish of such species as snook were absent, perhaps significantly.

The general absence of dead and dying fishes and the scarcity of living fishes in the marsh after 2 weeks and later suggests that much of the fish population commuting between the marsh and adjacent inshore shallows of Indian River was destroyed. (Auth. summ.)

1318. Waters, Thomas F. and Robert C. Ball. 1957. LIME APPLICATION TO A SOFT-WATER, UNPRODUCTIVE LAKE IN NORTHERN MICHIGAN. The Journal of Wildlife Management, Vol. 21, No. 4, October, pp. 385-391.

Lime application was made to Stoner Lake, in the Upper Peninsula of Michigan, to test the hypothesis that increasing the alkalinity of a soft-water, unproductive lake would increase biological productivity. A small application of hydrated lime and an application of crushed limestone failed to increase the alkalinity, while larger applications of hydrated lime increased the alkalinity from 6 p.p.m. to 15 p.p.m. During a four-year study of limnological conditions following the application of hydrated lime several extensive phytoplankton blooms were observed which caused the appearance of carbonate alkalinity and the corresponding rise in pH due to the extraction of carbon dioxide by the phytoplankton. One species of aquatic plant, Myriophyllum tenellum, was observed to increase markedly over previously barren sand bottom, and the standing crop of bottom organisms increased at one sampling station which had been invaded by the Myriophyllum. The growth of stunted yellow perch in their first year of life increased significantly. (Auth. summ.)

1319. Bennett, George W. and William F. Childers. 1957. THE SMALLMOUTH BASS, MICROPTERUS DOLOMIEUI, IN WARM-WATER PONDS. The Journal of Wildlife Management, Vol. 21, No. 4, October, pp. 414-424.

Smallmouth bass were able to live in 12 ponds representing most types of warm-water pond habitats located at or north of the latitude of central Illinois. They were observed to reproduce successfully in one-half of these ponds during and prior to the summer of 1956. Failure of smallmouths to reproduce in the other 6 ponds was believed to be related to an absence of sexually mature fish and their inability to compete successfully with large-mouth bass and green sunfish. Most successful smallmouth bass ponds were those in which smallmouths were by themselves or with some other fish less prolific than bluegills, green sunfish, or black bullheads.

A population of smallmouths in one lake (14.6 acres) expanded from 32 fish to 2,969 in two growing seasons. In the next four growing seasons, this population dropped from 697 bass returned following the 1952 census to 148 fish; the reduction was due to angling and failure of reproduction due to excessive competition with sunfish.

A 1.4-acre gravel-pit pond produced hook-and-line yields of smallmouth bass ranging from 78 to 123 pounds per acre during the fishing seasons of 1951-54, inclusive. These fish were caught at an average rate of about two fish or one pound per hour. When the pond was censused, it contained 52.3 pounds of bass per acre. This suggested the possibility of an annual turnover of more than 100 per cent of the standing crop

Smallmouths living alone in ponds became habitual surface feeders and for this reason were more easily taken on artificial flies and other surface lures than were smallmouths living in ponds with other kinds of fishes. (Auth. summ.)

1320. Neess, John C., William T. Helm, and C. William Threinen. 1957. SOME VITAL STATISTICS IN A HEAVILY EXPLOITED POPULATION OF CARP. The Journal of Wildlife Management, Vol. 21, No. 3, July, pp. 279-292.

Rates of natural mortality and recruitment have been investigated in a population of carp inhabiting Lake Wingra, a small hard-water lake in the vicinity of Madison, Wisconsin. The vital statistics were obtained from the results of several tag-and-recapture experiments carried out while the population was heavily exploited by a seine fishery. Average rates of natural mortality were found to be about 0.06 per month during the winter months of November, December, January and February, and about 0.04

per month during the others. During a two-year period in which the population was reduced by about 90 per cent by natural mortality and the fishery, reproduction remained negligible; recruitment to the catchable portion of the population was seemingly due to growth into the catchable size-range of individuals belonging to year-classes already present at the beginning of the period. Various errors affecting the computations are discussed in detail. (Auth. summ.)

1321. Massmann, William H. and Anthony L. Pacheco. 1957. SHAD CATCHES AND WATER TEMPERATURES IN VIRGINIA. The Journal of Wildlife Management, Vol. 21, No. 3, July, pp. 351-352.

A study of the relationship of water temperature and shad catches in the York River for the years 1953-56 showed that greatest catches-per-unit-effort were made at water temperatures of 45° to 59° F. Below a water temperature of 40° F. almost no shad were caught. (Auth. summ.)

1322. Bardach, John E. and Richard G. Bjorklund. 1957. THE TEMPERATURE SENSITIVITY OF SOME AMERICAN FRESHWATER FISHES. The American Naturalist, Vol. XCI, No. 859, July-August, pp. 233-251.

The mechanism involved in temperature perception, namely, areal or spatial summation from individual small skin fibers enables the fish to sense rapid temperature changes of about .05° C.

Although the "thermal background noise" in even a "stable" aquarium environment must often reach this level of fluctuation in heat energy flow such small changes are ordinarily ignored. Acuity of perception increases on training as small thermal changes become meaningful. The mechanism by which such fine discrimination can be achieved, is discussed. (Auth. summ.)

1323. Cushing, John E. and George L. Durall. 1957. ISOAGGLUTINATION IN FISH. The American Naturalist, Vol. XCI, No. 857, March-April, pp. 121-126.

Earlier papers have noted the potential value of erythrocyte antigens as aids in distinguishing separate breeding populations within single species of fish, and in studying the migrations and evolutions of these populations. Investigation of this possibility has disclosed individual variations in the antibody content of the sera of two species of tuna, species specific differences among fish erythrocyte antigens, and individual variations in the erythrocyte antigens of the oceanic skipjack. The present paper describes an isoaggultinin system that has been found in a population of brown bullheads. This system has particular interest from an evolutionary point of view for it extends our knowledge of the occurrence of reciprocal isoagglutination to the class Pisces. In addition it raises the possibility that natural isoantibodies may prove useful in studying antigenic variations within other species than those reported here. (Auth. summ.)

1324. Hubbs, Clark and Robert A. Reynolds. 1957. COPULATORY FUNCTION OF THE MODIFIED PECTORAL FIN OF GAMBUSIIN FISHES. The American Naturalist, Vol. XCI, No. 860, September-October, pp. 333-335.

Extreme modification of the pectoral fin to support the gonopodium during copulation occurs in Gambusia heterochir. As males of all species we have examined in this genus support the gonopodium with the pectoral fin, evolution of the structural change most likely follows that of the behavior. (Auth. summ.)

1325. Hallock, Richard J., D. H. Fry, Jr., and Don A. LaFaunce. 1957. THE USE OF WIRE FYKE TRAPS TO ESTIMATE THE RUNS OF ADULT SALMON AND STEELHEAD IN THE SACRAMENTO RIVER. California Fish and Game, Vol. 43, No. 4, October, pp. 271-298.

A brief history of the methods of enumerating the spawning runs of adult king salmon and steelhead rainbow trout in California's Central Valley is given. The method presently used on the Sacramento River is a tag and recovery system, with the fish being captured in large fyke traps. Detailed material lists and construction procedures are given for the traps, which are 10-foot diameter cylinders, $19\frac{1}{2}$ feet long. Details of operation and transportation are also presented. The traps captured 10-20% of the steelhead runs, 1% of the king salmon, and 11% of the silver salmon, when the latter consisted entirely of two-year-old males. The traps are quite size-selective for king salmon, and less so for steelhead. Other fishes captured in significant numbers were striped bass, American shad, and various species of catfishes, sunfishes and minnows. (D. A. L.)

1326. Butler, Robert L. 1957. THE DEVELOPMENT OF A VINYL PLASTIC SUBCUTANEOUS TAG FOR TROUT. California Fish and Game, Vol. 43, No. 3, July, pp. 201-212.

A subcutaneous vinyl plastic tag has been developed and is in current use in California. The tools and method of tagging are described and it has been demonstrated that the technique can be effectively learned in a relatively short time. Optimum tagging rate may be expected to be near 100 tags per hour.

Hatchery experimentation and field observations have demonstrated the following: (1) blistering may be the most serious problem related to tag retention; (2) blistering is not due to vinyl plastic toxicity, bacterial infection from the tools and/or the tag, or tag irritation; (3) differences in mortality between tagged and untagged fish could not be demonstrated; (4) the growth observed with various groups of hatchery fish was not hampered by tag application; (5) the experimentation has demonstrated that of the various methods and materials used the narrow tag plus isopropyl alcohol provides the best tag retention; (6) the tag can be seen by fishermen. Greater numbers are returned voluntarily than are checked or picked up by creel checkers.

No long-term tests in lakes and streams have yet been conducted to determine how effective the tag is for such fisheries. (Auth. summ.)

1327. Robins, C. Richard and Robert Rush Miller. 1957. CLASSIFICATION, VARIATION, AND DISTRIBUTION OF THE SCULPINS, GENUS COTTUS, INHABITING PACIFIC SLOPE WATERS IN CALIFORNIA AND SOUTHERN OREGON, WITH A KEY TO THE SPECIES. California Fish and Game, Vol. 43, No. 3, July, pp. 213-233.

The characters, distribution and geographic variation of C. tenuis, asperrimus, and princeps are treated and nomenclatural notes are given for klamathensis, aleuticus, gulosus, and asper. Emphasis in this paper has been directed toward working out relationships at the species level. Detailed studies need to be made in order to determine differentiation of subspecific value. The relationships of the fish fauna of the upper Klamath and Pit rivers is emphasized in a section on zoogeography, with a discussion of the origin and dispersal of the species of Cottus common to these two regions. A key to the species of Cottus in the Sacramento and Klamath drainages is presented. (Auth. summ.)

1328. Pintler, Herbert E. and William C. Johnson. 1958. CHEMICAL CONTROL OF ROUGH FISH IN THE RUSSIAN RIVER DRAINAGE, CALIFORNIA. California Fish and Game, Vol. 44, No. 2, April pp. 91-124.

Control of rough fish and improvement of the steelhead fishery were the objectives. The operational phases of the project took place over a three-year period from 1952 to 1954, inclusive, and included pretreatment population sampling and rechecking immediately following treatment. A total of 286 miles of stream, covering the tributaries and most of the main river, was chemically treated at an estimated cost of approximately $6,000, or $20 per mile. Slightly more than 9,720 pounds of cube powder were applied.

Twenty-nine species of fishes, including two lampreys, were observed following the treatment. From counts of dead fish it was estimated that the population in the drainage during the summer consisted of less than one percent game fish. The dominant rough fish was the Western sucker, representing 90 percent of the total. Roach, carp, and squawfish ranked second, third, and fourth in the population check. Salmonids, most of which were juvenile steelhead, were scarce except in the headwater areas of the tributary streams. Other game fish, of which the smallmouth bass was the most prominent, were so scarce that they could hardly provide a fishery. Observations following chemical treatment indicated an almost complete kill in the treated areas.

Electrosampling in 1955, the first year after treatment, indicated that at least temporary benefits were derived from the project. The sampling, which was largely restricted to the tributary streams, showed that the juvenile steelhead population was drastically reduced.

Future work will consist of an extensive sampling program and creel checks to evaluate the work in terms of benefits to the steelhead fishery. The economic feasibility of the project should be revealed by the permanency of the increase of game fish and the rate of recovery of the rough fish population. This part of the project may require as much as eight years. (From auth. summ.)

1329. Wales, J. H. 1958. TWO NEW BLOOD FLUKE PARASITES OF TROUT. California Fish and Game, Vol. 44, No. 2, April, pp. 125-136.

Two species of the digenetic trematode family, Sanguinicolidae, are described as new. These are Sanguinicola davisi and Sanguinicola klamathensis. The adult stage and the eggs of S. davisi have been found in the gill capillaries of domestic rainbow trout, Salmo gairdnerii, steelhead rainbow trout, S. g. kamloops, in the California range of the intermediate host snail, Oxytrema. The adult stage of S. klamathensis is known to occur in the renal vein of the Lahontan cutthroat trout, Salmo clarkii henshawi, and the eggs occur in the gill capillaries. The known distribution of this fluke is the Ft. Klamath fish hatchery, Klamath Co., Oregon. The intermediate host snail is Fluminicola seminalis. Both species of flukes have been known to cause mass mortalities of young trout in fish hatcheries and S. davisi is abundant in some populations of wild steelhead rainbow trout. (J. H. W.)

1330. Rosenblatt, Richard H. and Wayne J. Baldwin. 1958. A REVIEW OF THE EASTERN PACIFIC SHARKS OF THE GENUS CARCHARHINUS, WITH A REDESCRIPTION OF C. MALPELOENSIS (FOWLER) AND CALIFORNIA RECORDS OF C. REMOTUS (DUMERIL). California Fish and Game, Vol. 44, No. 2, April, pp. 137-159.

A systematic account, with key, of the genus Carcharhinus.

1331. Stephens, Robert C., Rex L. Fisher and Richard G. Miller. 1957. FOOD PREFERENCES OF CALIFORNIA SURF FISHES WITH A REVIEW OF AVAILABLE BAITS. Transactions of the Twenty-second North American Wildlife Conference, pp. 445-457.

Three hundred and thirty-seven stomachs representing nine surf fish species were examined quantitatively in 1954 and 1955. The natural diet is compared with the 17 kinds of bait commercially available. These are described, with notation of sources, abundance, and suitability of each. Popularity among the fishermen of the marketed baits is tabulated and indicates the fisherman has arrived at a fair approximation of the suitable foods in his choice of baits.

Organisms in the diets of spotfin, yellow and white croaker, California corbina, opaleye, walleye and barred surfperch, rubberlip and shiner perch are tabulated for percent of volume and percent frequency of occurrence. Sandcrab, jackknife clam and sea mussel are widely accepted baits, especially among the larger species and individuals. They are heavily used by fishermen. Natural utilization of the bean clam, Donax gouldii, is sufficient to suggest its adoption as a bait.

Captive opaleye showed preference for bay mussel and jackknife clam, and for garden peas and corn. Captive bay blackperch showed preference for bay mussel and sand crab. (R. G. M.)

1332. Silliman, Ralph P. and James S. Gutsell. 1957. RESPONSE OF LABORATORY FISH POPULATIONS TO FISHING RATES. Transactions of the Twenty-second North American Wildlife Conference, pp. 464-471.

Four laboratory populations of guppies were grown in small aquaria under laboratory conditions of controlled light, temperature and food supply. Successive applications of fishing rates of 25, 10, 50, and 75 percent per triweekly period produced major changes in the experimental populations not duplicated in the controls. The general effect of exploitation was to produce a decrease in the size of the population, the amount of the decrease varying upward with the exploitation rate, until at the 75 percent rate the test populations were extinguished. Equilibrium yield was found to be related to fishing rate in the manner of a humped curve, with maximal yield at fishing rates between 30 and 40 percent, when the populations were at approximately one third their asymptotic weight.

The conventional fishery measures, i.e. catch, catch-per-unit-effort, and average fish length, were calculated and found to yield a large amount of information about population size and results of changes in rate of exploitation. (R. P. S.)

1333. Schaefer, Milner B. 1957. UTILIZATION AND CONSERVATION OF THE TUNA RESOURCES OF THE EASTERN TROPICAL PACIFIC OCEAN. Transactions of the Twenty-second North American Wildlife Conference, pp. 472-484.

The fishery for the tropical tunas, which is the most valuable fishery in the Eastern Pacific Ocean, exploits the populations of yellowfin tuna and skipjack, occurring off the coasts of the Americas from California to Peru. These tuna populations, and the effects of the fishery on them, are being investigated by a staff of scientists of the Inter-American Tropical Tuna Commission, in order to provide the factual basis for maintaining the yield of the fishery at the maximum sustainable level year after year. Six years of scientific study have provided estimates of the current condition of the tuna stocks, knowledge of many of the aspects of their life history, and some information on their ecology. The intensity of fishing for yellowfin tuna is believed to be near, but somewhat below, the level corresponding to maximum sustainable yield. For skipjack, on the contrary, the intensity appears to be well below that corresponding to maximum yield, and a large increase in the harvest is biologically possible. Future expansion of the fishery must depend on increased utilization of skipjack. The data being gathered by the Commission will make possible the designing of efficient conservation regulations at such time as they are needed.

1334. Rawson, D. S. 1956. THE LIFE HISTORY AND ECOLOGY OF THE YELLOW WALLEYE STIZOSTEDION VITREUM, IN LAC LA RONGE, SASKATCHEWAN. Transactions of The American Fisheries Society, 1956, pp. 15-37.

The yellow walleye population of Lac la Ronge was studied from 1950 to 1956 using creel census, tagging, trapping the spawning run and extensive gill netting.

Spawning runs of thirteen to thirty thousand walleyes enter the Montreal and Potato Rivers a few days after the ice leaves the rivers and small lakes but much earlier than the break-up of ice on Lac la Ronge. Maximum spawning activity was in water temperatures of 45-50° F. Males outnumber females in the run by 5 to 1. A few spawned at 5 years but the bulk of the run was 8 to 10 years old.

The rate of growth of walleyes in Lac la Ronge is intermediate as compared to that recorded elsewhere in Canada and in the United States. Females grow considerably faster than males. The food was 97 percent fish with ciscoes and ninespine sticklebacks as the main items. External and internal parasites are reported.

Movements of the walleye population were followed through the spawning run, gradual return to the main lake, and late summer dispersal into deep water. Greater activity was demonstrated at night than during the day. Seventy percent of the recoveries were within two miles of the tagging site and only 5 percent more than 20 miles away. One walleye had gone 65 miles upstream. Tagging and other evidence suggests that the spawning runs of two rivers about 6 miles apart represent essentially discrete populations.

The angler's catch of walleyes, averaging 41,000 pounds per year, is of the same order as the previous commercial catch. Six years of creel census indicates that the walleyes have contributed steadily, about 17 percent of the game fish catch. The population appears quite capable of supporting present rates of utilization. (Auth. abst.)

1335. Bates, Daniel W. and Russell Vinsonhaler. 1957. USE OF LOUVERS FOR GUIDING FISH. Transactions of The American Fisheries Society Eighty-Sixth Annual Meeting, 1956, pp. 38-57.

Late in 1951, the U. S. Bureau of Reclamation completed construction of the world's second largest pumping plant at Tracy, California. In connection with this project, it was found that facilities would have to be installed to prevent fish of several species and as short as 10 millimeters from passing into the pump intakes.

Because of the magnitude of the project and lack of knowledge as to the best protective facility, a test structure with several types of fish screens was installed. Fish stopped by the screens were collected by a port and riser system. Tests revealed that none of these facilities adequately met fish protection requirements at Tracy. It was therefore necessary to consider other methods. Research by members of a team from the U. S. Fish and Wildlife

Service and the Bureau of Reclamation developed a louver system for guiding fish.

The louver system consists of a fence-like series of vertical steel slats set with their broad faces at right angles to the direction of flow and placed across the channel in a diagonal line terminating at a narrow by-pass. When fish approach the louver slats, particularly when water velocities are high they tend to avoid them and swim away at an angle of about 90 degrees. In maintaining this position, they place themselves somewhat broadside to the approach flow and are carried downstream, through the by-pass and either into the main stream or a holding pond.

Efficiency studies of louvers in a test flume and in the pilot structure indicated that striped bass, salmon, shad, catfish, and other species can be successfully diverted and collected by this system. (Auth. abst.)

1336. Kinney, Edward C. 1957. THE OTTER TRAWL AS A FISH SAMPLING DEVICE IN WESTERN LAKE ERIE. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 58-60.

Periodic fish collections were made in western Lake Erie with a thirty-foot otter trawl from 1948 through 1953. Prior to 1952, the number of silver chubs, Hybopsis storeriana, per collection were recorded for some of the trips. Biweekly trawls, usually consisting of four one-acre hauls, were made during 1952 and 1953. Records of the numbers of silver chubs per haul were kept. When hauls made during the spring migration period were excluded, a mean of 18.2 adults per haul was obtained with a standard deviation of 4.7. The results were sufficiently consistent to be used as a basis for further population comparisons. (Auth. abst.)

1337. Wolf, Ken. 1957. EXPERIMENTAL INDUCTION OF BLUE-SAC DISEASE. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 61-70.

Blue-sac disease, an abnormal condition of sac fry, has been recognized for nearly 90 years. At least 23 postulated causes have been advanced, but reports of consistently reproducible results have not been found in literature. Methods whereby blue-sac disease was induced at will are described. Closed-system incubation, whereby metabolic wastes accumulated, resulted in incidences of blue-sac disease roughly proportional to the period of holding and to ammonia concentrations which developed. Blue-sac disease was also induced by adding synthetic nitrogen compounds to water used for incubating eggs and fry.

1338. Hacker, Vernon A. 1957. BIOLOGY AND MANAGEMENT OF LAKE TROUT IN GREEN LAKE, WISCONSIN. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 71-83.

Information on spawning, feeding habits and on growth and condition of planted lake trout in Green Lake, Wisconsin, is presented. Failure of natural reproduction of the planted trout of Great Lakes stock in this lake is attributed to lack of cover for the eggs on the spawning bar and subsequent predation by Necturus. An artificial spawning bed of angular fragments of rock deposited on the spawning bar in 60 to 100 feet of water appears to be providing the necessary egg protection. In this oligotrophic lake of 7,325 acres Mysis is the main food of immature trout shorter than 14 inches and ciscoes the principal food of adult trout longer than 27 inches. Length-weight relationship is of the usual pattern and coefficient of condition for the younger fish about the same as that reported for Great Lakes trout but is higher for the larger adult fish. Average egg production of 18 females, at least 12 years old, was 5,417 eggs in the fall of 1956. It is suggested that selection of an unfavorable deep-water spawning area in preference to more suitable areas in shallower water is inherent in the race of trout stocked here. (Auth. abst.)

1339. Larkin, P. A., J. G. Terpenning, and R. R. Parker. 1957. SIZE AS A DETERMINANT OF GROWTH RATE IN RAINBOW TROUT SALMO GAIRDNERI. Transactions of the American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 84-96.

Growth rates of rainbow trout have been calculated and compared for 27 British Columbia lakes. The use of absolute age as a reference point is unsatisfactory in many cases where comparisons involve fish of the same age but of dissimilar sizes. Changes in metabolic efficiency may be primarily a function of size and not of age. An alternative method is suggested, which relates growth rate to size independent of age. Examples are offered of the use of size--specific average instantaneous growth rates. (Auth. abst.)

1340. Miller, Robert Rush. 1957. ORIGIN AND DISPERSAL OF THE ALEWIFE, ALOSA PSEUDOHARENGUS, AND THE GIZZARD SHAD, DOROSOMA CEPEDIANUM, IN THE GREAT LAKES. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 97-111.

It is possible that the alewife is native to Lake Ontario and the gizzard shad to Lake Erie, although conclusive evidence for this is lacking. There appear to be no records of the alewife from Lake Ontario prior to 1873, after the lake had been stocked with American shad. That species may still occur in Lake Ontario occasionally. A tabular comparison of these species is given to facilitate identification. The alewife is referred to the genus Alosa (rather than Pomolobus) because no reliable characteristics are available to distinguish the species of these two groups.

Wilmot recorded a herring-like fish (not the American shad) from Lake Ontario about 1837 which probably was the gizzard shad, though it may have been the alewife. The first record of gizzard shad in Lake Ontario is for 1913, but the species was reported from Lake Erie in 1848, 18 years after the completion of the first canal to connect Lake Erie and the Ohio River. It is hypothesized that the gizzard shad entered

Lake Erie in pre-Columbian times during a warm-dry period.

A chronological record of the appearance of alewives in the upper Great Lakes shows the first specimen reported from Lake Erie was taken in 1931, Lake Huron 1933, Lake Michigan 1949, and Lake Superior 1954; actual dates of first appearance in each lake are unknown, but the species obviously moved from Lake Erie to the other lakes via Detroit River and Lake St. Clair. The alewife did not become abundant in Lake Erie or Lake Huron until around 1950 or in Lake Michigan until about 1956; it is widely distributed but not yet abundant in Lake Superior. The phenomenal increase in abundance and spreading of the alewife may be correlated with the upset in population balance by the sea lamprey; catch statistics for the alewife and shallow water cisco (Coregonus artedii) from South Bay, Lake Huron, suggest a direct or indirect causal relationship during 1954-1956.

The gizzard shad does not occur north of lower New York Harbor (and there only rarely) on the Atlantic slope, although it has been reported from New Brunswick, where it was probably misidentified for the alewife. Its inland range has been extended by canal connections and perhaps it reached Lake Erie in this way; it definitely entered Lake Michigan through the Chicago River canal. A reference in 1874 to the "saw-belly" from the Great Lakes undoubtedly represents the gizzard shad, also known by that name. The species has evidently spread to Lake Ontario and the vicinity of Quebec by moving through the Welland Canal, and to Lake Huron via the Detroit River and Lake St. Clair. The first specimen known to be taken in Lake Michigan was caught on October 13, 1953, west of Muskegon, Michigan; another was taken near Gary, Indiana, on November 2, 1953. The gizzard shad has not been reported from Lake Superior where cold, deep water may prohibit its establishment. It has on occasion gained some commercial importance in Lakes Erie and Huron, where 31,600 pounds valued at $930 were taken in 1949. The gizzard shad may have been aided in expanding northward by the warming climatic trend of the past half century.

The two species, particularly the alewife, are steadily increasing in abundance and methods of utilizing this new resource should be devised. (Auth. abst.)

1341. Henderson, Croswell and Richard F. Foster. 1957. STUDIES OF SMALLMOUTH BLACK BASS (MICROPTERUS DOLOMIEU) IN THE COLUMBIA RIVER NEAR RICHLAND, WASHINGTON. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 112-127.

Observations on smallmouth black bass, Micropterus dolomieu, of the Columbia River were possible because of a transplantation program undertaken by local sportsmen and because of studies made by the U. S. Public Health Service and the General Electric Company to evaluate effects of the radioactive effluent from the Hanford reactors. The average bass caught with sport-fishing gear was $15\frac{1}{2}$ inches long and weighed 40 ounces. Females were larger and made up a greater portion of the catch than males. Age was from three to eleven years but seven and eight-year-old fish made up about half of the catch. Growth was rapid in spite of a short season and water temperatures below that considered optimum.

Some spawning occurred in sloughs as early as April, but was unsuccessful because of a subsequent drop in temperature. Fry hatched from eggs spawned in July and August when temperatures were from 60 to 75° F. Transplanted bass move about considerably, but a definite migratory pattern was not established. Some fish moved over forty miles and many returned to the place of initial capture.

Radioactive materials, which originated in the effluent from the reactors, were acquired by the bass through food chains. The principal isotope concentrated in the fish and other river animals was radiophosphorus. The level of radioactivity in the bass was greatest in September and least in April. No adverse effects on bass or food organisms, attributable to radioactive effluents, could be detected. The radioactive contamination of the bass was too low to constitute a hazard to persons who might eat them. (Auth. abst.)

1342. Budd, John. 1957. MOVEMENTS OF TAGGED WHITEFISH IN NORTHERN LAKE HURON AND GEORGIAN BAY. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 128-134.

Recapture pattern of whitefish tagged in South Bay, northern Lake Huron, suggests a major migration route east along the south shore of Manitoulin Island into Georgian Bay. Tagged whitefish leave South Bay in early summer, spend the remainder of the year outside and return again the following spring. No fish tagged in Georgian Bay were recaptured outside that body of water. Tagging seems to indicate two discrete populations. Study is based on recaptures from 5,901 tagged whitefish of legal and sub-legal size (14-20 inches fork length) during the years 1949-1953. (Auth. abst.)

1343. Motl, L. F. 1957. EXPERIMENTAL SPIRAL RACEWAY FOR TROUT. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, p. 135.

A single-wall raceway with the wall curved in a spiral, from the engineering point of view, has several advantages. There is a substantial saving in construction costs because of elimination of one concrete wall. Such a raceway is compact and requires less space than a conventional raceway of similar length. Water sewer lines and air lines, with which to aerate the water, are required in about 25 percent the amount needed in a raceway of the usual type.

In an area with cold winters, frost damage to concrete raceway walls is an ever-present problem. In the spiral raceway the area of wall exposed to frost is reduced and thereby a longer useful life of the structure is probable. Another engineering

advantage is that the water input is at the center of the spiral which is raised to provide the necessary fall in the raceway. The compact nature of the spiral raceway makes a combination of a head of water and a long gradually sloping area for conventional raceways unnecessary. Any area lower than the water supply can be used.

1344. Seguin, Louis-Roch. 1957. SCIENTIFIC FISH CULTURE IN QUEBEC SINCE 1945. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 136-143.

In Quebec, a number of experiments have been undertaken to improve the quality of the trout reared for planting purposes. Data are presented on efficiency of diets and effects of light and temperature on reproduction, incubation, growth and survival of brook trout (Salvelinus fontinalis), lake trout (Salvelinus namaycush), Quebec red trout (Salvelinus alpinus marstoni), rainbow trout (Salmo gairdneri), brown trout (Salmo trutta) and Atlantic salmon (Salmo salar) and on hybrids between these species, especially the brook-lake trout hybrid (splake). (Auth. abst.)

1345. Ruhr, C. E. 1957. EFFECT OF STREAM IMPOUNDMENT IN TENNESSEE ON THE FISH POPULATIONS OF TRIBUTARY STREAMS. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 144-157.

Data from a statewide survey of warm water streams in Tennessee were used to determine the extent to which gizzard shad (Dorosoma cepedianum), carp (Cyprinus carpio), smallmouth buffalo (Ictiobus bubalus), and drum (Aplodinotus grunniens) inhabit smallmouth bass-rock bass streams. Reproduction of those species in tributary streams was minor or absent. By comparing samples from streams that were accessible from an impoundment and streams that were in an unimpounded watershed, it was shown that large populations of gizzard shad, carp, smallmouth buffalo, and drum in streams originate in impoundments. Mill dams on tributary streams were found to be effective barriers to the upstream movement of fish from the impoundment. Once reservoir fish populations were well established, there appeared to be no consistent variation in the populations of lake fish in tributary streams from one reservoir to another. In streams without migration barriers there was no decrease in the concentration of lake fish with an increase in the distance from an impoundment. Population pressure among fish of the various species in the impoundment is advanced as the reason for movement of gizzard shad, carp, smallmouth buffalo, and drum into streams. It is suggested that mill dams be preserved as barriers to movement of lake fish and that pre-impoundment surveys include consideration of the effect not only on the inundated stream but on the streams above the full-pool level of the proposed reservoir. (Auth. abst.)

1346. Sand, Reidar F. 1957. APPLICATION OF UNDERWATER TELEVISION TO FISHING GEAR RESEARCH. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 158-160.

Development and application of closed circuit underwater television for use in fisheries investigations is described. It has been used successfully in Florida coastal waters as a tool in studies of marine fishery methods and equipment.

1347. Stevens, Richard I. and John R. Truog. 1957. COMPARISON OF DRIED YEASTS, CANDIDA UTILIS AND SACCHAROMYCES CEREVISIAE, AS SUPPLEMENTS IN A DIET FOR RAINBOW TROUT. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 161-168.

A single grade of the yeast Saccharomyces cerevisiae and three grades of the yeast Candida utilis were tested as growth stimulants and as vitamin sources when fed in a dry pelleted diet to rainbow trout. At levels of 4 percent, 8 percent and 15 percent of dry yeast in the diet, growth was stimulated and conversion ratios improved. Maximum growth occurred on 8-percent yeast diets. With the exception of one grade of C. utilis, all yeasts at the same levels in the diet gave similar results.

Vitamin analyses indicated that diets enriched with 4-percent of yeast were deficient in meeting the daily requirement levels of B-vitamins. Because no appreciable mortality occurred after feeding these diets for 18 weeks, it is suggested that reported daily requirements are high. Storage of diets at room temperature for 180 days had little destructive effect on B-vitamin content, except some loss in niacin occurred. A commercial pelleting process effected no loss in B-vitamin content.

The mortalities of trout on yeast-fortified diets and the yeast-free diet were similar. Liver necrosis in trout on the diets for 33 weeks appeared to a like degree for all diets tested. At similar levels in the diet, C. utilis yeasts promoted higher storage levels of biotin. Trout on 8-percent yeast diets had less liver biotin than those on 4-percent yeast, 15-percent yeast and yeast-free diets.

When trout are fed a pelleted diet at 60 percent of that recommended in Cortland Feeding Chart they attained a coefficient of condition, empirically expressed as "R", of 1.80 to 1.86 on the yeast supplemented diets and of 1.73 of the yeast-free diet. (Auth. abst.)

1348. Joeris, Leonard S. 1957. STRUCTURE AND GROWTH OF SCALES OF YELLOW PERCH OF GREEN BAY. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 169-194.

The appearance of the scales of yellow perch differs with the location on the fish's body. Comparison of scales of Green Bay perch taken above and below the lateral line reveals the former to have more sharply defined circuli and to exhibit fewer false annuli and less of the shading that impedes accurate assessment of age.

Estimates of age from modes in length-frequency distributions and from scale readings were the same for age groups O, I, and II. Older age groups could

not be detected in length distributions, but the similarity of all annuli makes it acceptable to conclude that the annulus is in fact a year-mark at ages beyond the II group.

Scales of yellow perch may exhibit new growth in the latter part of May whereas others may not have started growing even in late July. The time of annulus formation varies with calendar year, with age (new growth starts earlier in the younger fish), and possibly with locality. Ages usually can be read from scales collected during the period of annulus formation, but occasionally difficulties are encountered.

For larger yellow perch the relation between fish length and the radius of key scales was described by a straight line with a 2-inch intercept on the length axis when the scales were taken above the lateral line and by a straight line through the origin when the scales came from below the lateral line. Lengths calculated from both relations were inaccurate for small fish. Tables of corrections are given, based on the body-scale curves for small perch.

The body-scale relations (determined from the same key scale) were similar for Lake Erie and Saginaw Bay perch but both differed sharply from the relation in the Green Bay populations.

Good procedure requires high consistency in the field as to the point on the fish's body from which scale samples are taken and also a careful determination of the body-scale relation in each population studied. (Auth. abst.)

1349. Whiteleather, Richard T. 1957. SOME INTERESTING ASPECTS OF FISHERIES EXPLORATION - 1956. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 195-198.

Annual fishery production of the United States must be increased at least 500 million pounds by 1965 to meet demands of population growth. From our knowledge of the commercial fisheries it appears that an additional supply of such magnitude will be found only by pushing our fishery frontiers seaward; by examining the mid-water regions of known fishing areas and by improving fishing gear. In 1956, fisheries exploration has located new deep-water shrimp resources in the Gulf of Mexico and off the South Atlantic coast of the United States. It has also led to charting of productive shrimp grounds in the North Pacific Ocean off the Washington coast. Gaps in the knowledge of the seasonal distribution of yellowfin tuna in the Gulf of Mexico have been closed. With the development of a prototype telemeter for attachment to a mid-water trawl to give continuous depth and temperature information, the potentialities of this fishing gear are improved. (Auth. abst.)

1350. Blair, A. A. 1957. COUNTING FENCE OF NETTING. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 199-207.

A two-way fence of netting is described. It has been used for counting ascending adult salmon (Salmo salar) and descending salmon smolts in Newfoundland rivers near the mouth where depths have ranged from 1 to 9 feet. The traps and barriers are constructed in sections which can be easily dismantled and transported to another river. Also sections of netting in the barriers which become clogged with debris during flood conditions can be readily replaced with clean sections. (Auth. abst.)

1351. Ide, F. P. 1957. EFFECT OF FOREST SPRAYING WITH DDT ON AQUATIC INSECTS OF SALMON STREAMS. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 208-219.

Number and volume of aquatic insects emerging from tributaries of the Miramichi River of northern New Brunswick, where forest-covered watersheds had been sprayed from the air with 0.5 pounds of DDT per acre, are compared with insect emergence from unsprayed streams. Adult insects were captured as they emerged from the water in yard-square cage-traps. In the streams affected by DDT fewer kinds of insects, particularly of the larger species such as caddisflies, were found. The sprayed streams had, generally, larger numbers than the unsprayed but in all sprayed streams the volume represented was significantly lower because of the relative scarcity of the larger forms. The insect fauna of the sprayed streams was found to be deficient in the kind of insects on which the salmon were mainly feeding in the unsprayed streams. (Auth. abst.)

1352. Hourston, W. R. and D. MacKinnon. 1957. USE OF AN ARTIFICIAL SPAWNING CHANNEL BY SALMON. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 220-230.

Investigation of effect of a proposed hydro-electric development on the salmon spawning grounds in Jones Creek, British Columbia in 1949 indicated spawning areas would be so affected that only a small portion of existing runs could be maintained. Methods for preserving the run were suggested and one selected that involved the construction of an artificial spawning channel capable of supporting the existing runs with provision for controlling the flow in the channel and by-passing surplus flows.

Behavior studies of pink salmon (Oncorhynchus gorbuscha) and chum salmon (O. keta) spawning in the channel were made in 1955 and the survival from egg to fry was determined in 1956 when there was survival of 37 percent of the 428,000 pink salmon eggs calculated to have been available for deposition and 30 percent of the 251,000 chum salmon eggs calculated to have been available for deposition. (Auth. abst.)

1353. Martin, Nigel V. 1957. REPRODUCTION OF LAKE TROUT IN ALGONQUIN PARK, ONTARIO. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 231-244.

In lakes of Algonquin Park, Ontario, lake trout (Salvelinus namaycush namaycush) spawn on clean, wave swept shoals of broken rubble ranging from $1\frac{1}{2}$ to 4 inches in diameter and in water from 6 inches to 12 feet deep. Weather conditions may influence the time and duration of the reproductive period but it most often occurs in the last half of October and lasts about 10 days. Water surface temperatures are

usually between 50 and 55° F. Spawning occurs chiefly at night from sunset to about 10:30 p.m. Nightly counts were made of the fish on the beds during spawning in Lake Louisa in 1947. Courtship behaviour is described. Males made up 60-85 percent of the spawning population. The size composition of the spawning population varied markedly from lake to lake because of different growth rates. The smaller trout spawn first.

Egg frequency estimates on the spawning beds averaged 50 per square foot. Saprolegnia infection of the eggs on the beds appears to be the main cause of egg mortality. Northern brown bullhead (Ameiurus nebulosus) and Menominee Whitefish (Prosopium cylindraceum quadrilaterale) were the chief egg predators. Water level drawdowns in late fall and winter may expose some eggs and make large areas of potential beds unavailable for spawning.

Time of hatching ranges from mid-February to late March, an incubation period of 15 to 21 weeks. The fry leave the spawning beds by at least mid-May. (Auth. abst.)

1354. Tarzwell, Clarence M. and Croswell Henderson. 1957. TOXICITY OF DIELDRIN TO FISH. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 245-257.

Toxicity bio-assays of run-off water from an area treated with dieldrin at the rate of 4.66 pounds per acre indicated that the run-off from the first rain following treatment was toxic to fathead minnows, Pimephales promelas, at a dilution of one in three. Mortality in run-off from the third rain was less than 50 percent, and a few fish exhibited the characteristic effects of dieldrin when placed in run-off from the fourth rain following treatment. It is evident that run-off from an extensive area treated with dieldrin would adversely affect fish life.

A time-of-effect concentration curve was prepared by exposing fish to known concentrations of dieldrin. Tests with samples, the concentrations of which were unknown to the investigators, indicated that within the range of 0.03 to 0.5 p.p.m., the dieldrin concentration could be estimated within 25 percent. By using this curve it was estimated that the composite sample of run-off contained 0.128 p.p.m. of dieldrin.

Bio-assays with different formulations of dieldrin showed that it was extremely toxic to three different species of fish. The 96-hour TL/m values ranged from 0.0056 to 0.042 p.p.m., depending on the formulation and the kind of fish.

Tests, when using dilution waters with different characteristics, indicated that dieldrin was somewhat more toxic in hard than in soft waters. While larger volumes per fish of the test solution appeared to be slightly more toxic, evidence was not sufficient to establish that absorption of dieldrin by fish reduced the toxicity of test solutions. (Auth. abst.)

1355. Prevost, Gustave. 1957. USE OF ARTIFICIAL AND NATURAL SPAWNING BEDS BY LAKE TROUT. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 258-260.

Artificial spawning beds for lake trout, made of sharp rocks, are better than natural spawning beds of round boulders. The eggs laid in the interstices between the sharp rocks are thereby protected to a certain extent against depredation by other fish, whereas, eggs laid on round boulders are easily reached by predators. SCUBA diving equipment was used to make observations of the spawning beds. (Auth. abst.)

1356. Thomas, Ronald C. and Richard B. Miller. 1957. ALBERTA'S 'POTHOLE' TROUT FISHERIES. Transactions of the American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 261-268.

Scattered across the prairies and foothills of Alberta lie a series of warm, shallow, rich lakes and reservoirs that vary in size from 15 to 100 acres. These "potholes" are distinguished from the larger lakes of the province by their lack of inlets and outlets. Some contain northern pike and yellow perch; others have small cyprinids only, or cyprinids and sticklebacks; one contains yellow perch and sticklebacks.

The potholes without northern pike, when stocked in the spring with fry or fingerlings of rainbow trout, provide fishing for 13- to 16-ounce fish by fall and for two to three pound fish by the second summer. From the first two stockings it is estimated that anglers recover roughly one-fifth of the total number and some sixty times the total weight of fish stocked. In the spring and fall the anglers catch about one fish per hour; during July to mid-September angling is poor and from 12 to 20 hours are required to catch one fish. This poor fishing is attributed to warm surface waters and low oxygen concentrations in deeper waters.

Trout fry or fingerlings stocked in third and subsequent years grow poorly and survive in small numbers. This is believed to be due to competition with the population established by the first two stockings. The management problems are discussed and it is concluded that poisoning the whole population every three or four years and beginning again is the best procedure. (Auth. abst.)

1357. McLain, Alberton L. 1957. THE CONTROL OF THE UPSTREAM MOVEMENT OF FISH WITH PULSATED DIRECT CURRENT. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 269-284.

Alternating-current electromechanical devices installed in the mouths of streams have proved effective in stopping the spawning migrations of the parasitic sea lamprey (Petromyzon marinus) which has seriously damaged Great Lakes fisheries. In a few streams, excessive mortality has occurred to other fish at the alternating-current barriers. A direct-current unit was developed in an attempt to reduce this mortality. This direct-current "diversion device" consists of a row of suspended negative electrodes which begins at the end of a trap wing and extends across the river at a downstream angle of 45° and a series of pipes (positive electrodes)

driven into the stream bank. A second array, consisting of horizontal pipes installed downstream and parallel to the suspended electrodes and connected to a series of rods driven into the bank near the positive electrodes, controls the electrical field and dissipates the collecting influence of the positive side of the circuit. The electrical field is established from the end of the trap wing to the opposite bank. Fish are diverted away from the negative electrodes and toward the bank near which the trap is located. The array is activated by pulsated direct current of essentially square wave shape with pulses at a duty cycle of 0.66 and a repetition rate of 3 per second. Direct-current diversion devices were operated in conjunction with alternating-current barriers during 1956 in the Chocolay River, Marquette County, and the Silver River, Baraga County, Michigan.

A total of 15,814 fish comprising 21 species was handled at the Chocolay River with a mortality of 930, or 5.9 percent. If mortalities of fish moving downstream are disregarded, only 287, or 1.9 percent, of the fish moving upstream were killed in the Chocolay River.

In the Silver River, 78,648 fish comprising 21 species were taken from the trap of the direct-current diversion device. The total kill of fish moving upstream, including 289 sea lampreys, was 1,016, or 1.3 percent. This river had presented a serious problem in the operation of an alternating-current control device during previous seasons. In 1955, 85.5 percent of three important species of fish were killed at the control structure. During 1956, this mortality was reduced to 8.1 percent by the operation of the direct-current equipment. (Auth. abst.)

1358. Johnson, Fritz H. 1957. NORTHERN PIKE YEAR-CLASS STRENGTH AND SPRING WATER LEVELS. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 285-293.

Relationships between spring water levels and strength of year classes of northern pike (Esox lucius) produced in Ball Club Lake of north-central Minnesota are considered for the 7 years between 1945 and 1952. The years are ranked according to water conditions, including height during spawning and fluctuation during egg incubation, and according to the strength of year classes produced as judged from their abundance in the darkhouse spearing catch. Comparison of these two rankings by a rank difference correlation shows a correlation of 0.61. It is concluded that a high spring water level during spawning and a small decline in the levels during egg incubation represent good conditions and for the production of a strong northern pike year class. (Auth. abst.)

1359. Cushing, Colbert E., Jr. and John R. Olive. 1957. EFFECTS OF TOXAPHENE AND ROTENONE UPON THE MACROSCOPIC BOTTOM FAUNA OF TWO NORTHERN COLORADO RESERVOIRS. The Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 294-301.

Two northern Colorado reservoirs, Reservoir No. 4 and Smith Lake, were treated with fish toxicants to eliminate the rough fish. An investigation was conducted to ascertain the effects of toxaphene and derris (rotenone) upon the macroscopic bottom fauna. Reservoir No. 2 was used as a control. Bottom fauna were collected by four Ekman dredge hauls made on each of the reservoirs at approximately two-week intervals between October 21, 1954, and September 30, 1955.

The application of approximately 0.1 p.p.m. toxaphene had a marked effect upon the Tendipedidae (Chironomidae) population in Reservoir No. 4. Living larvae were absent from the samples within three days following the poisoning. Re-population of the lake was not complete until July, nine months after poisoning. The Chaoborus larvae exhibited no immediate effects from the toxaphene, although the larvae were absent from a sample taken six months after poisoning and had not reappeared by termination of the study. The Oligochaetes exhibited no adverse effects from the toxaphene, but rather increased in numbers from the beginning until completion of the study.

The application of approximately 1.0 p.p.m. derris (rotenone) did not affect the tendipedid population of Smith Lake to the extent that toxaphene affected it in Reservoir No. 4. The sample collected three days after the poisoning contained 40 larvae, the majority of which were dead. This was the only sample which indicated any extensive effects of the poison. The oligochaetes exhibited an initial increase after poisoning but the population soon became relatively stable.

Toxaphene had a much greater immediate and residual effect upon the Tendipedidae than did the rotenone. The Oligochaeta were not adversely affected by either poison. (Auth. abst.)

1360. Walburg, Charles H. 1957. OBSERVATIONS ON THE FOOD AND GROWTH OF JUVENILE AMERICAN SHAD, ALOSA SAPIDISSIMA. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 302-306.

Previous studies on the food habits of juvenile American shad have been restricted to one area such as an individual river or a group of ponds. In this study juveniles were obtained from six widely separated rivers. It was found that the food taken, mostly insects and crustaceans, was approximately the same in all rivers sampled. In general young shad appeared to utilize those food organisms which were most available in their habitat at a particular time. Phytoplankton was not observed in any of the 453 stomachs examined. The average lengths of the shad sampled from the various rivers, excluding the Pamunkey River sample, were similar although the southern river samples spawned earlier than those from the more northern rivers. (Auth abst.)

1361. Grassl, E. F. 1957. PELLETED DRY RATIONS FOR TROUT PROPAGATION IN MICHIGAN HATCHERIES. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 307-322.

Diets of pelleted animal and vegetable meals were

compared with dry-meal and chopped raw-meat diets as food of rainbow and brook trout. Evaluation was made by bimonthly measurement of weight and length, daily mortality, and physiological changes. Pelleted dry-meal diets were not accepted immediately as food by rainbow and brook trout. This was evidenced by a loss of weight during the first two weeks of feeding pelleted food. Lost weight was regained after four weeks of feeding. All dry-meal ingredients pelleted in the combinations used were acceptable as trout food when supplemented with raw beef liver at least one day every three weeks. Dry diets resulted in no reduction of growth rates when fed at one-half to five-eights the amounts recommended for raw-meat mixtures. A diet containing brewers yeast produced a greater gain in weight of rainbow trout than an otherwise identical diet containing torula yeast. Also, it was found that a pelleted diet was superior to a raw beef liver diet. The adoption of dry pelleted diets as standard rations by all state fish hatcheries in Michigan increased trout production in pounds by 60 percent and reduced fish food expenditures by 40 percent. (Auth. abst.)

1362. Baldwin, N. S. 1957. FOOD CONSUMPTION AND GROWTH OF BROOK TROUT AT DIFFERENT TEMPERATURES. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 323-328.

Food consumption (minnows) and weight gained by individual brook trout held at six temperatures within the range 3.5° to 21.0° C. are described relative to their body weight. The trout consumed most food and made best growth at 13° C. Utilization for growth of food consumed declined with increase in temperature. (Auth. abst.)

1363. Waters, Thomas F. 1957. THE EFFECTS OF LIME APPLICATION TO ACID BOG LAKES IN NORTHERN MICHIGAN. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 329-344.

To investigate the observed correlation between alkalinity and productivity of lake waters and to test the use of lime in bog lakes to increase biological productivity, lime application was made to two acid, soft-water, colored bog lakes in the upper peninsula of Michigan. Lime application was made twice to each of the two lakes, once in the summer under thermally stratified conditions and once in the autumn under nearly honothermous conditions, by pumping a lime-water mixture into the surface waters. Total rate of lime application was 100 pounds per acre-foot in each lake.

The summer lime applications resulted in raising the pH and increasing alkalinity, total hardness and conductivity in the epilimnion only. The autumn application resulted in similar effects in the lower hypolimnion, because of sinking of the denser lime solution to the bottom where because of its greater density it did not later mix with upper layers.

Lime application did not decrease the organic colloidal color.

Total phosphorus was greatly increased in the bottom waters of one treated lake which originally was low in total phosphorus but there was no significant increase in the bottom waters of the other treated lake where total phosphorus concentrations were originally high. Total phosphorus also increased temporarily in the epilimnion of one lake following the summer application.

A bloom of nannoplankton (Microcystis aeruginosa) was observed in one lake following the release of epilimnial phosphorus. Chemical data indicated that because of the presence of higher bicarbonate concentrations, the nannoplankton utilized carbon dioxide at a rate which may not have been possible without lime application. In both lakes the following summer, significantly higher standing crops of net phytoplankton were observed (principally of Dinobryon sertularia). Increases in standing crop of zooplankton also occurred the year following lime application. (Auth. abst.)

1364. Vladykov, Vadim D. 1957. FISH TAGS AND TAGGING IN QUEBEC WATERS. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 345-349.

During the 12-year period, from 1945 to 1956, 19,310 fish of 13 species were tagged in Quebec. Three types of tags were used. From 1938 to 1940, monel metal strap tags, adapted from the "cattle ear tag" were tried, but were discarded as unsatisfactory. Since 1940 two different types designed by the author have been used. Ring-shaped strap tags of monel or nickel have been found satisfactory for tagging some species such as sturgeon, channel catfish, and eel. For other fishes, such as shad, smelt, striped bass, tomcod, split ring and plate tags are more advantageous. In the case of two species of sturgeon, several fish with strap tags were recovered 10 and 11 years after liberation. The maximum distances between tagging and recovery points in Quebec tagged fishes were 892 miles for Atlantic sturgeon and 1,650 miles for shad. (Auth. abst.)

1365. Donaldson, Lauren R., Donald D. Hansler, and Terry N. Buckridge. 1957. INTERRACIAL HYBRIDIZATION OF CUTTHROAT TROUT, SALMO CLARKII, AND ITS USE IN FISHERIES MANAGEMENT. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 350-360.

Two races of coastal cutthroat trout (Salmo clarkii) were hybridized and the resultant first generation hybrids were compared with the two parent races. In both laboratory and field studies the hybrids showed evidence of hybrid vigor. The catch of sports fishermen, during two seasons at Echo Lake, Washington, where both parent and hybrid trout were planted, was composed of three to six times as many fish of the hybrid stocks as of the parent races.

1366. Moorman, Robert B. 1957. SOME FACTORS RELATED TO SUCCESS OF FISH POPULATIONS IN IOWA FARM PONDS. Transactions of The American

Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 361-370.

Minnow seines and larger bag seines were used to determine the reproductive success of fish in all (60) farm ponds known to have been stocked with fish in Marion County, Iowa. Additional data on lengths, weights, ages, and abundance of the fish were collected from many of the ponds. Ponds smaller than 0.5 acre were less successful than larger ponds. Fifteen of 26 ponds stocked with the bass-bluegill-bullhead combination were successful, and four of 18 ponds stocked with the bass-bluegill-bullhead combination were successful. The rates of stocking within the range of 300 to 1,000 bluegills per acre in combination with bass had little influence on success or failure of fish ponds. Pond management practices by the farm operator were generally limited to fencing for exclusion of livestock. The ponds were not heavily fished, and harvest did not exceed 65 pounds of fish per acre per year at the most heavily fished ponds. Clay turbidity probably delayed growth of bass. Aquatic vegetation was not important in determining success of fish populations. Winterkill occurred one or more times in the fish populations of 31 of the 60 ponds. (Auth. abst.)

1367. Whalls, Marvin J., David S. Shetter, and James E. Vondett. 1957. A SIMPLIFIED ROTARY FISH SCREEN AND AN AUTOMATIC WATER GATE. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 371-380.

A simplified rotary fish screen and an automatic water gate have been developed for use in streams or hatchery raceways. This self-cleaning screen is designed to replace stationary, vertical screens which become plugged with leaves, sticks, and other water-borne debris and require periodic cleaning in order to prevent water level fluctuations in raceways. It is of simple construction, operates for long periods, and is readily portable. It is not designed to replace large-capacity, gear-driven rotary screens.

The gate is used in conjunction with a gear-driven rotary screen, and is designed to open automatically during floods and pass water through the screen and to close automatically and seal off the screen when the water recedes to a normal level. (Auth. abst.)

1368. Dymond, J. R. 1957. ARTIFICIAL PROPAGATION IN THE MANAGEMENT OF GREAT LAKES FISHERIES. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 384-392.

No positive evidence has been found to suggest that artificial propagation has ever been successful in significantly increasing the yield of a native species in the Great Lakes.

The possible contribution of artificial propagation to the populations of Great Lakes fish has been investigated in three ways: by looking for correlations between the numbers of fry planted and the size of the commercial catch in the years when the resulting individuals would have entered the fishery in the greatest numbers; through experiments in which fry are planted only in alternate years and the relative strengths of year classes in appropriate number of years later determined; through experiments in which marked lake trout fingerlings are planted and the number subsequently caught recorded. Neither of the two types of experiment has been carried on long enough to yield decisive results.

From a consideration of the history of some unusually successful year classes and some unusually unsuccessful year classes it is concluded that the size of a year class is determined by conditions affecting hatching and survival rather than by the size of the spawning stock, which is usually adequate to produce large populations if environmental conditions are favorable. Far too much confidence has been placed in the planting of hatchery-reared fish as a means of maintaining or increasing fish populations. (Auth. abst.)

1369. Moffett, James W. 1957. RECENT CHANGES IN THE DEEP-WATER FISH POPULATIONS OF LAKE MICHIGAN. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 393-408.

The deep-water fish fauna of Lake Michigan consisted of lake trout (Salvelinus namaycush), burbot (Lota lota maculosa), seven species of chubs or deep-water ciscoes (Leucichthys spp.), and the deep-water sculpin (Myoxocephalus quadricornis). Other species occupied the deep-water zone but were not typically part of the fauna. Lake trout, burbot, and a well established commercial fishery held the chub population in somewhat of a balance until the sea lamprey (Petromyzon marinus) destroyed the lake trout and burbot. Released from predation, one species of chub (L. hoyi) increased until its abundance in 1955 was 347 percent of that in 1930-1933. It is the smallest and most slowly growing of the chubs in the lake. Other chubs were reduced in abundance (1954-1955 abundance only 37 percent of that of 1930-1932) by an increased fishing pressure and by sea lamprey predation which shifted to them when lake trout and burbot became practically extinct.

Selective destruction of the large chubs reduced the average length by 1.5 and 2.2 inches in the northern and southern portions of the lake, respectively, and practically eliminated two largest species (L. johannae and L. nigripinnis). Chubs over 10 inches long made up 72 percent of the catches in 1930-1932, but only 21.5 percent in 1954-1955. (Auth. abst.)

1370. Smith, Stanford H. 1957. LIMNOLOGICAL SURVEYS OF THE GREAT LAKES--EARLY AND RECENT. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 409-418.

Early explorations on the Great Lakes were concerned largely with things easily collected or observed--common organisms, water levels, surface temperatures. . . . Even when more scientific studies were undertaken, they were at first scattered and small-scale. Effective surveys became possible only through inter-agency cooperation which permits a pooling of facilities, staff, and equipment. Expansion of limnological research on the Great Lakes

has been rapid in later years and the outlook for the future is good. (Auth. abst.)

1371. Kennedy, W. A. 1957. CURRENT FISHERIES RESEARCH BY CANADIANS ON THE GREAT LAKES. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 419-423.

The activities indicated are reviewed. They fall into two categories: 1. A contribution towards eliminating sea lamprey from the Great Lakes; 2. Some general fishery research. (Auth. abst.)

1372. Farley, John L. 1957. THE ROLE OF THE GREAT LAKES FISHERY COMMISSION IN THE SOLUTION OF GREAT LAKES PROBLEMS. Transactions of The American Fisheries Society Eighty-sixth Annual Meeting, 1956, pp. 424-429.

The Great Lakes Fishery Commission was established by treaty between the United States and Canada. Under the terms of the Convention the Commission is charged with the implementation of a program for the control of the sea lamprey and with the coordination of fishery research by various agencies. In the performance of its duties with respect to sea lamprey the Commission has contracted the operational phase of the program to the Fish and Wildlife Service in the United States and to the Fisheries Research Board in Canada. The Commission does not plan to engage in research but has the authority to do so should circumstances require.

Primary responsibility for preparing and recommending to the Commission the programs for sea lamprey control and fishery research lies with the five-man Scientific Advisory Committee, headed by the Executive Secretary of the Commission and having two members each from the United States and Canada. This Committee is aided by consultants from all regions of the Great Lakes. Further advice will be given to the United States and Canadian Sections of the Commission by lake Advisory Committees.

Present organizational arrangements must be reviewed as tentative and subject to modification in the light of continuing experience. (Auth. abst.)

1373. Springer, Stewart. 1957. TUNA RESOURCES OF THE TROPICAL AND SUB-TROPICAL WESTERN ATLANTIC. Transactions of The American Fisheries Society Eighty-fifth Annual Meeting, 1955, pp. 13-17.

Eight species of tunas and bonitos are known to occur in the Gulf of Mexico, Caribbean Sea, and adjacent Atlantic waters. Seven of these have been utilized, at least on a small scale, in commercial packs of canned tuna. Gulf and Caribbean catches of some species have been processed for the first time as recently as 1955.

The presence of tuna as a widely distributed resource available to longlines was demonstrated by the U. S. Fish and Wildlife Service exploratory fishing vessel Oregon in 1954 and 1955, supporting the views of a few earlier observers that the rare appearance of large numbers of tuna in Gulf and Caribbean offshore waters indicated the existence of a diverse but substantial sub-surface population.

Effective exploitation of the resource and the development of a prosperous longline fishery probably depends on many factors, not limited to, but including the development of a stable market at locations convenient to fishermen and rapid extension of our knowledge of the areas and seasons for best fishing. (Auth. abst.)

1374. Clemens, Howard P. and Joe C. Finnell. 1957. BIOLOGICAL CONDITIONS IN A BRINE-POLLUTED STREAM IN OKLAHOMA. Transactions of The American Fisheries Society Eighty-fifth Annual Meeting, 1955, pp. 18-27.

A year-round study was made of a prairie stream polluted with brine wastes from oil wells to learn more about the biological conditions in waters high in chlorides. Concentrations ranged from 20,000 p.p.m. chlorides at the headwaters to 100 p.p.m. at the confluence of the brine-polluted stream and a larger stream. The average number of kinds of organisms found in waters with various concentrations of chloride was : 16,000 to 20,000 p.p.m. --4.0; 11,000 to 16,000 p.p.m. --4.8; 8,000 to 11,000 p.p.m. --6.5; 4,000 to 8,000 p.p.m. --8.5; 1,000 to 4,000 p.p.m. --9.3; 100 to 1,000 p.p.m. --13.0. The 34 kinds or organisms in the stream throughout the year are arranged according to their chloride tolerance. These animals include fish, crustaceans, nematodes, insects, rotifers, and protozoans. (Auth. abst.)

1375. Moyle, John B. and Donald R. Franklin. 1957. QUANTITATIVE CREEL CENSUS ON 12 MINNESOTA LAKES. Transactions of The American Fisheries Society Eighty-fifth Annual Meeting, 1955, pp. 28-38.

A sampling technique is described for quantitative creel census on large lakes with numerous public access points. By use of contacts with anglers and boat counts over spaced intervals, one man, working a 5-day and 40-hour work week, can obtain an estimate of sport fishing pressure and harvest and of goodness of fishing on two lakes.

A summary and comparison of census results from the 12 lakes totalling 15,136 acres is given along with discussion of reliability of census methods. During the fishing year 1954 (December 1, 1953 to November 30, 1954) mean fishing pressure on the lakes was 36.8 hours per acre; mean harvest was 30.7 fish and 17.8 pounds of fish per acre; and mean rate of catch for summer anglers 0.83 fish and 0.47 pound of fish per hour. Fishing harvest by summer angling, winter angling, and winter spearing are compared and trends in the catch and habits of fishermen for the three years 1952-54 are described. During the 3 years of census total fishing pressure and harvest on the lakes appear to have increased about 15 percent but goodness of fishing has remained nearly constant. (Auth. abst.)

1376. Funk, John L. 1957. MOVEMENT OF STREAM FISHES IN MISSOURI. Transactions of The American Fisheries Society Eighty-fifth Annual Meeting, 1955, pp. 39-57.

Eight hundred forty-six reports of tagged fish

caught by anglers were analyzed to determine the movement patterns of 14 species of native warm-water stream fishes. Each species included a sedentary group which remained near the release point and a mobile group which ranged more or less freely. The species could be classified according to the relative abundance of the two groups. Rock bass, smallmouth bass, longear sunfish, spotted bass, and yellow bullhead were classified as sedentary species; carp, flathead catfish, largemouth bass, golden redhorse, and black redhorse are semi-mobile; and channel catfish, freshwater drum, and white crappie as mobile.

The species varied greatly in the average number of days between tagging and recapture and in the direction of movement and distances traveled by the mobile fish. The mobile group usually was free longer than the sedentary fish but frequently the difference in time was not great. Mobile freshwater drum, golden redhorse, black redhorse, spotted bass, largemouth bass, and longear sunfish tended to travel relatively long distances downstream and much shorter distances upstream. The distances traveled by the remaining species were more nearly equal but the average distance traveled upstream was always the longer. Mobile yellow bullhead, green sunfish, spotted bass, longear sunfish, and largemouth bass seldom traveled more than 25 miles but some mobile carp moved over 200 miles. Other species traveled intermediate distances.

When released in headwaters, sedentary species tended to be more sedentary, and semi-mobile species in their preferred habitat also tended to be more sedentary than the average. Mobile species and semi-mobile species not in their preferred habitat became more mobile. Most of the mobile fish released in headwaters moved downstream.

For the four most numerous species (rock bass, channel catfish, carp, smallmouth bass) data are presented to show the effect of release location, season, and age upon movement. Rock bass were more sedentary in headwaters than farther downstream but channel catfish were more mobile in headwaters. Mobile fish of both species tended to move downstream when released in headwaters but to make more upstream movements when released in downstream areas. Carp seemed to adapt their movements to the physical conditions in the habitat. They were mostly sedentary in stable habitats but predominantly mobile in habitats subject to flooding. The subspecies of the fish, the type of stream, and the geographical location of the release site may have affected the amount and direction of movements of smallmouth bass. All four species showed a relatively high proportion of mobile fish in the spring and low proportions in the summer. Data on fall movements were not conclusive. Rock bass, channel catfish, and smallmouth bass of intermediate age were more mobile than either the younger or the older fish.

The concept that the native population of warm-water stream fish species consists of a sedentary and a mobile group provides a logical explanation of many observed phenomena and of contradictory results which have confused some investigators. It supplements recent findings concerning the home ranges of species if it is assumed that only the sedentary group was investigated. (Auth. abst.)

1377. Jenkins, Robert M. 1957. THE EFFECT OF GIZZARD SHAD ON THE FISH POPULATION OF A SMALL OKLAHOMA LAKE. Transactions of The American Fisheries Society Eighty-fifth Annual Meeting, 1955, pp. 58-74.

Estimates of the standing crop of fish in two small Oklahoma lakes were made by the short-period simultaneous mark-and-recovery method, employing wire traps. The lakes were similar in physical and chemical characteristics, and each contained bluegill, black and white crappie, redear sunfish, largemouth bass, warmouth, black bullhead, and Gambusia. The one lake which also contained gizzard shad, carp, and green sunfish was treated with rotenone to check the accuracy of the population estimate. The lake without gizzard shad had an estimated standing crop of 655 pounds per acre, 608 pounds of which was composed of desirable-sized fish. Recovery from the lake treated with rotenone indicated a standing crop of 1,043 pounds per acre but the weight of desirable-sized fish was 142 pounds per acre less than in the lake without shad. The faster growth, plumper condition, and greater average length of fishes in the lake without shad indicated that direct interspecific competition occurs between centrarchids and gizzard shad in small-lake populations.

The failure of an estimated 39 percent of the fish killed to appear following rotenone treatment emphasizes the necessity for employing the mark-and-recovery method in population studies. The catches of the cylindrical, 1-inch-mesh wire traps did not reflect adequately the numbers of gizzard shad, large carp, and largemouth bass. Other types of gear must be devised to determine accurately and efficiently the standing crops of these species. (Auth. abst.)

1378. Parsons, John W. 1957. THE TROUT FISHERY OF THE TAILWATER BELOW DALE HOLLOW RESERVOIR. Transactions of The American Fisheries Society Eighty-fifth Annual Meeting, 1955, pp. 75-92.

The 7.3 miles of tailwater below Dale Hollow Dam were initially stocked with rainbow trout (Salmo gairdneri) in 1950. In 1953, creel records indicated that a minimum of 16 percent of the 16,500 fingerling-stocked fish were captured by anglers within 12 months after stocking. The rainbow trout creeled averaged 9.4 inches long, and had grown at a monthly rate of 15 millimeters in length and 26 grams in weight. On the basis of growth rates it was decided that an annual stocking of approximately 25,000 fingerling rainbow trout would most benefit the fishery. To maintain suitable water temperatures throughout the tailwater in the summer, a minimum cold-water discharge below the dam was established. Threadfin shad (Signalosa petenensis) were stocked in the reservoir in an attempt to establish a supplemental food supply for trout in the tailwater. The stocking of brown trout (Salmo trutta), brook trout (Salvelinus fontinalis), and cutthroat trout (Salmo

clarki) in the tailwater has been only slightly successful. The Dale Hollow tailwater presently supports 7,000 put-and-take trout-fishing trips per year at a cost to the Tennessee Game and Fish Commission of less than 20 cents per trip. (Auth. abst.)

1379. Donaldson, Lauren R. and Paul R. Olson. 1957. DEVELOPMENT OF RAINBOW TROUT BROOD STOCK BY SELECTIVE BREEDING. Transactions of The American Fisheries Society Eighty-fifth Annual Metting, 1955, pp. 93-101.

Management programs to maintain and increase the sports fishery require large numbers of strong, healthy, acclimatized fingerlings for restocking the lakes and streams. To produce the fingerling trout needed, stocks of fish are first developed and selected at fishery laboratories, then tested in the field. At the University of Washington over a period of 23 years of intensive selective breeding, rainbow trout (Salmo gairdnerii) stocks have shown increased growth rate, earlier maturity, increased tolerance to warm water temperatures, resistance to disease, and greatly increased egg production. The egg production has been most satisfactory, rising from an average of less than 1,000 eggs from 4-year-old spawners in 1932 to an average of 3,894 eggs for 2-year-old females, 5,029 for 3-year-old females, and 4,984 eggs for 4-year-old females in 1955. (Auth. abst.)

1380. Eschmeyer, Paul H. 1957. THE NEAR EXTINCTION OF LAKE TROUT IN LAKE MICHIGAN. Transactions of The American Fisheries Society Eighty-fifth Annual Meeting, 1955, pp. 102- 119.

After the collapse of the commercial fishery for lake trout (Salvelinus namaycush) in Lake Michigan in the late 1940's, the further decline of the population was traced by records of numbers of small lake trout (mostly 11 to 16 inches in total length and 3 to 5 years old) caught in small-mesh nets of the chub (Coregonus) /=Leucichthys/ spp.) fishery. By 1951 the estimated abundance of these lake trout in lower Lake Michigan was only about 4 percent of their abundance prior to the invasion of the sea lamprey (Petromyzon marinus). This remnant of the population declined severely in subsequent years to a point near extinction by 1955. In April-July 1955 only 8 lake trout were caught in $5\frac{1}{2}$ million linear feet of gill net.

Statistics of the lake trout and chub fisheries in State of Michigan waters of Lake Michigan for the years 1929-1954 give no indication that the destruction of small lake trout in the chub fishery had any effect on the later abundance of lake trout of commercial size, or that this destruction was a significant factor in the collapse of the lake trout fishery.

Lake trout were brought near extinction by lethal attacks of the sea lamprey and by the near or perhaps complete failure of natural reproduction in 1949 and subsequently.

Comparisons in 1949 and 1950 of numbers of legal-sized lake trout caught in large-mesh nets with numbers of small fish taken in chub nets showed that both large and small lake trout declined over the same period, and that by these years the decline may have been greater among small than among legal-sized fish. (Auth. abst.)

1381. Caldwell, David K., Howard T. Odum, Thomas R. Hellier, Jr., and Frederick H. Berry. 1957. POPULATIONS OF SPOTTED SUNFISH AND FLORIDA LARGEMOUTH BASS IN A CONSTANT-TEMPERATURE SPRING. Transactions of The American Fisheries Society Eighty-fifth Annual Meeting, 1955, pp. 120-134.

Populations of spotted sunfish, Lepomis punctatus punctatus (Valenciennes) and Florida largemouth bass, Micropterus salmoides floridanus (LeSueur) have been studied in the fertile biotic communities of Silver Springs, Florida. This large limestone spring has a constant temperature, nearly constant chemical environment, and stable biological communities, but a seasonal change in light intensity and general productivity. Studies of the scales of these two species have shown rings which are possibly rhythmic but not related to temperature. Strong rings in spotted Sunfish are apparently too numerous to be annuli and their formation is not correlated with the time of year. The spotted sunfish population reproduces mainly in spring and summer, although there is evidence for some scattered winter breeding. Age groups do not stand out distinctly in length-frequency diagrams. Reproduction by Florida largemouth bass appears to be chiefly limited to spring and summer. Thus, even with a constant temperature, there are apparently cycles in the life history of these fishes which cause the periods of increased reproduction to coincide with periods of greater food production. Recaptures of tagged bass and measurements of spotted sunfish in cages within the springs indicated moderate growth rates. Tagging with individual color combinations for visual study indicated little movement by the spotted sunfish, but a high mortality. Data are included on the length-weight and body-scale relationships, degree of scale regeneration, and food. The seasonal activities of centrarchid populations are adjusted to make use of the maximum flow of productive energy in spring and summer and are thus correlated with the photoperiodic cycle. (Auth. abst.)

1382. Fry, F. E. J. and K. E. F. Watt. 1957. YIELDS OF YEAR CLASSES OF THE SMALLMOUTH BASS HATCHED IN THE DECADE OF 1940 IN MANITOULIN ISLAND WATERS. Transactions of The American Fisheries Society Eighty-fifth Annual Meeting, 1955, pp. 135-143.

Yields of smallmouth bass (Micropterus dolomieui) hatched in the years 1941 through 1949 have been estimated for South Bay, Lake Huron. Subsidiary estimates for bass in neighboring waters were also made. Fluctuations in year-class strength appear to be more or less synchronous throughout the district. Variations in yield from the year classes in South Bay correlated directly with the algebraic sum of the monthly deviations from the mean air tempera-

tures over the months July through October of the year of hatching. (Auth. abst.)

1383. Scruggs, George D., Jr. 1957. REPRODUCTION OF RESIDENT STRIPED BASS IN SANTEE-COOPER RESERVOIR, SOUTH CAROLINA Transactions of The American Fisheries Society Eighty-fifth Annual Meeting, 1955, pp. 144-159.

An unprecedented sport fishery for striped bass, Roccus saxatilis (Walbaum), has developed in the Santee-Cooper Reservoir within the past 10 years. From a creel census from September 1, 1954, to August 31, 1955, the annual harvest was conservatively estimated to exceed 64,000 striped bass; this species accounted for 6.7 percent of the total harvest (by number) of all game fish caught.

Exchanges between the reservoir population and those making seasonal runs in lower Cooper River is restricted to the navigation lock at Pinopolis Dam. Two methods were used during 1954 and 1955 to determine the extent of movement. Year-round fishing with a large trammel net indicated very limited use of the lock by striped bass. In 1954, a total of 606 striped bass were captured, tagged, and released in the Tailrace Canal below Pinopolis Dam. Out of 37 recaptures 33 were caught downstream, revealing a seasonal migratory trend, and only 4 had moved through the lock into the reservoir.

To determine sexual maturity of striped bass in the reservoir, 165 male and 243 female fish were examined between February 16, and June 1, 1955. Most of the males were ripe by the end of March. Changes in the ratio of gonad to body weight were used to classify the stage of maturity of the females. A small percentage of the females were mature at 20 inches, total length. More than 88 percent of all females over 24 inches long had maturing, mature, or spent ovaries.

The principal spawning grounds in the reservoir were located in 1954 by the collection of eggs in large plankton nets. In 1955 a more intensive study revealed that the spawning period started during the first week of April and reached a peak between April 21 and May 5. The minimum temperature for spawning was 58° F.

Most of the striped bass in Santee-Cooper Reservoir are land-locked and apparently are able to complete a full life cycle in fresh water. (Auth. abst.)

1384. Cope, Oliver B. 1957. SIX YEARS OF CATCH STATISTICS ON YELLOWSTONE LAKE. Transactions of The American Fisheries Society Eighty-fifth Annual Meeting, 1955, pp. 160-179.

The U. S. Fish and Wildlife Service collected catch statistics on Yellowstone Lake and adjacent waters from 1950 to 1955 as part of an investigation on the status of the cutthroat trout fishery and the fish populations. Methods for estimating numbers of fishermen, hours of effort, and catch, were developed for each unit of the fishery and were used to compute estimates for all years of the 6-year period.

One feature of this fishery is the presence of only one species of sport fish in these waters. Another is an unusual hourly distribution of fishing throughout the day. Very little fishing is done before 7 a.m. and thereafter three peak periods of fishing effort occur, in the late morning, in the afternoon, and in the evening. Another characteristic is a remarkable uniformity of angling pressure among days of the week. The "resort" character of the Yellowstone situation explains these unusual tendencies. Good opportunity also is afforded in this fishery for studies on the effects of changes in regulations.

Distribution of fishing effort according to area and season has been very constant from year to year. The Fishing Bridge fishery peaks early in the year and declines rapidly. The West Thumb fishery is smaller, but is sustained throughout the season. The lake outlet area accounted for 30 percent of the total catch of Yellowstone Lake, and 27 percent of the combined lake and river catch. The components of the fishery contributed the following average annual catches: West Thumb Dock guides and rowboats, 25,450 fish, or 9.98 percent of the lake total; Fishing Bridge Dock guides and rowboats, 54,239 fish, or 21.27 percent; Lake Dock guides and rowboats, 33,387 fish, or 13.09 percent; lake shoreline, 65,271 fish, or 25.60 percent; Fishing Bridge 6,474 fish or 2.53 percent; private boats, 70,123 fish, or 27.50 percent. The average annual lake catch for the 6-year period was 254,944 fish. The average catch in the river was 33,575 or 13.16 percent of the lake catch.

Trends for the lake and river fishery as a whole show an increase in fishing effort up to 1952, followed by a small reduction in 1953 and increases in 1954 and 1955. Fishing effort varied with the numbers of tourists, although the reduction in fishing pressure from 1952 to 1953 was greater than the reduction in numbers of tourists. The successes of individual components of the fishery have fluctuated independently of each other from year to year. The catch per fisherman hour for river and lake combined in 1955 was 0.671 fish, compared with 0.510 in 1951, 0.519 in 1952, 0.508 in 1953, and 0.584 in 1954.

Reductions in mean lengths of the catch were evident up to 1952. The mean lengths were greater for 1953-1955 than those of 1952, a condition that is attributed to weak year classes.

The reduction of the limit from five to three fish in 1953 did little toward reducing total catch, but the shortened season had a decided effect on the reduction of the catch. (Auth. abst.)

1385. Hooper, Frank F. and Alfred R. Grzenda. 1957. THE USE OF TOXAPHENE AS A FISH POISON. Transactions of The American Fisheries Society Eighty-fifth Annual Meeting, 1955, pp. 180-190

Standard laboratory bio-assay tests on the insecticide toxaphene indicated that this chemical is more toxic to fish in hard water than in soft water. Its toxicity to the bluntnose minnow was increased approximately three-fold by raising the temperature from 50° to 75° F. This insecticide was found to be much more toxic to the bluntnose minnow than to any

of four aquatic invertebrates tested. The laboratory work supported field observations on two Michigan lakes. Many groups of invertebrates were killed by toxaphene treatment, but they reappeared while the lake water was still toxic to fish.

Detoxification of water stored in the laboratory proceeded most rapidly when it was exposed to light, when the oxygen content was high, and when the temperature was high. Hard water (alkalinity, 212 p.p.m.) detoxified more rapidly than soft water (alkalinity, 6 p.p.m.). Detoxification was greatly accelerated by water movements which brought the toxicant in contact with the walls and bottom of the aquarium. The rate of detoxification was increased by the addition of a substrate of glass marbles or gravel. Sand and mud assisted detoxification to a lesser extent. Sterilization of the substrate with dilute formalin and carbolic acid inhibited detoxification; this indicated that microorganisms were responsible for reducing toxicity. (Auth. abst.)

1386. Maloney, J. E. and F. H. Johnson. 1957. LIFE HISTORIES AND INTER-RELATIONSHIPS OF WALLEYE AND YELLOW PERCH, ESPECIALLY DURING THEIR FIRST SUMMER, IN TWO MINNESOTA LAKES. Transactions of The American Fisheries Society Eighty-fifth Annual Meeting, 1955, pp. 191-202.

Shoreline seining of two typical large Minnesota walleye lakes, Mille Lacs and Winnibigoshish, during the summers of 1954 and 1955 showed young-of-year yellow perch and walleye to be closely associated. Throughout the summer the young walleyes were always larger than the young perch. The average length of walleye ranged from about 1.2 inches in late June to 4.8 inches in late August; that of perch growth for the same period ranged from about 0.9 to 2.5 inches. Food studies demonstrated that throughout the summer young perch fed mostly on plankton crustaceans and aquatic insects and young walleyes fed mostly on fish, especially yellow perch. Yearling and older perch taken from the same seining areas fed principally on plankton crustacea and insects during the first part of the summer and shifted somewhat to fish as the season progressed. Considerable numbers of young walleyes and perch were taken from the seining areas in the summer of 1954. Largest catches of young-of-year walleyes in 1954 were made in July when 1,206 per shoreline acre were taken from Mille Lacs and 795 from Winnibigoshish. In 1955, however, similar seining took markedly fewer fish in Mille Lacs Lake and showed a different seasonal distribution of the catch from Lake Winnibigoshish. Possible reasons for these differences are discussed. The close association of young-of-year walleyes and yellow perch along shores together with their differences of growth rate and feeding habits suggest that in typical walleye lakes the size of the perch crop may be an important factor in determining the year-class strength of the associated walleyes. (Auth. abst.)

1387. Olson, P. A. and R. F. Foster. 1957. TEMPERATURE TOLERANCE OF EGGS AND YOUNG OF COLUMBIA RIVER CHINOOK SALMON. Transactions of The American Fisheries Society Eighty-fifth Annual Meeting, 1955, pp. 203-207.

A study was made on the temperature tolerance of eggs and young of chinook salmon which spawn in the main stem of the Columbia River. The control temperature followed a seasonal trend typical for the locality. It started at 57° F., reached a minimum of 36° F., and increased to 47° F. at the end of the test. Other experimental lots averaged about 4° F. colder and 2° F., 4° F., and 8° F. warmer than the control throughout the greater part of the test.

Significant mortality above that of the control occurred only in the warmest lot. Although about 90 percent of the eggs in this group hatched successfully, the fry and early fingerlings suffered heavy mortalities even though the mean temperature of this lot was well below 50° F. during the fingerling stage.

The results of this single experiment indicated that the eggs could begin incubation at temperatures as high as 61° F. without significant loss. (Auth. abst.)

1388. Byrd, I. B. and D. D. Moss. 1957. THE PRODUCTION AND MANAGEMENT OF ALABAMA'S STATE-OWNED PUBLIC FISHING LAKES. Transactions of The American Fisheries Society Eighty-fifth Annual Meeting, 1955, pp. 208-216.

The construction of lakes by the State Department of Conservation was initiated to provide fishing in those areas having insufficient fishing waters. The lakes were constructed on carefully selected sites so that they could be managed for maximum fish production. Efforts were made to eliminate all native fish from the streams, ponds, and potholes within the entire watershed in addition to those in the lake area prior to stocking with bluegill (Lepomis macroshirus), redear sunfish (Lepomis microlophus), and largemouth bass (Micropterus salmoides). To keep these lakes in balance and producing high annual yields of fish, it was necessary to employ various management techniques, including fertilization, fish-population control, corrective restocking, and control of aquatic weeds and algae.

Alabama has 11 managed lakes containing a total of 591 acres that have been open to public fishing for 2 to 5 years. Three of the lakes, totalling 155 acres, have been opened for 5 years, 3 containing 163 acres for 4 years, 1 with 40 acres for 3 years, and 4 containing 233 acres for 2 years. During the time that these lakes have been opened, they have provided a total of 379,460 fisherman-trips in which the anglers caught a total of 1,291,012 fish weighing 364,062 pounds. These lakes, therefore, provided an annual average of 189 fisherman-trips per acre and an annual average catch of 642 fish weighing 180.9 pounds per acre. Although the lakes were subjected to extremely heavy fishing pressure, the average catch per fisherman-trip was 3.4 fish weighing 0.96 pound. (Auth. abst.)

1389. Neuhold, John M. 1957. AGE AND GROWTH OF THE UTAH CHUB, GILA ATRARIA (GIRARD), IN PANGUITCH LAKE AND NAVAJO LAKE, UTAH, FROM SCALES AND OPERCULAR BONES. Transactions of the American Fisheries Society Eighty-fifth Annual Meeting, 1955, pp. 217-233

Age and growth were calculated for 222 Utah chubs collected from Panguitch Lake and 212 Utah chubs collected from Navajo Lake, southern Utah, in 1952-1953 from both scales and opercular bones. Scales were measured with the aid of a projector. Opercular bones were measured directly. The center of growth of the opercular bone is posterior to the posterior lip of the fulcrum. Correction for curvature is necessary in opercular bone measurements. Agreement of dominant age classes for successive years, agreement of empirical length-frequency modes of young fish with calculated length-frequency modes of lower age classes, agreement of ages as indicated by scales and opercular bones, agreement of age with sexually immature fish, and an increase in length with an increase in age are accepted as evidence in support of both methods. The opercular-bone method displays no appreciable advantages over the scale method. (Auth. abst.)

1390. Lennon, Robert E., and Phillip S. Parker. 1957. ELECTRIC SHOCKER DEVELOPMENTS ON SOUTHEASTERN TROUT WATERS. Transactions of The American Fisheries Society, Eighty-fifth Annual Meeting, 1955, pp. 234-240.

The many problems involved in making fish collections and population surveys in trout streams of the Shenandoah and Great Smokey Mountains National Parks led to an investigation of electrofishing methods. These soft-water streams have electrical resistivities ranging as high as 117,000 ohms cm^3. Grounded electrode systems of conventional design proved ineffective in such waters.

The Petty-type, alternate-polarity electrode system of original and modified design has been successfully tested in Park streams having resistivities of 32,000 to 117,000 ohms cm^3. The addition of trailers to the electrode system has produced substantial improvements in the strength and range of the effective, electrical field in the water. The alternating current power sources for the electrodes include a gasoline-driven portable generator and a battery-powered backpack unit which produce 240 and 250 volts, respectively. (Auth. abst.)

1391. Mraz, Donald and C. W. Threinen. 1957. ANGLER'S HARVEST, GROWTH RATE AND POPULATION ESTIMATE OF THE LARGEMOUTH BASS OF BROWNS LAKE, WISCONSIN. Transactions of The American Fisheries Society Eighty-fifth Annual Meeting, 1955, pp. 241-256.

An apparent abundance of largemouth bass (Micropterus salmoides) below legal length in Browns Lake, Wisconsin, led to an experimental liberalization of angling regulations in which the minimum size limit was eliminated and the open season was lengthened. As a start towards the evaluation of these measures a study has been made of the angler's harvest and of the growth rate of the bass, and the size of the bass population has been estimated.

A partial creel census indicated that an angling pressure amounting to 75 hours per acre harvested a total of 2,671 largemouth bass in 30,091 hours. Sixty-two percent of the largemouth bass were over 10 inches long and 38 percent less than 10 inches, the former minimum legal size. The earlier opening of the season permitted capture of more large individuals.

The relationship between the anterior scale radius (inches $\times 44$) and the total length (inches) of largemouth bass was described satisfactorily by the equation $S = 0.1813\ L^{1.3613}$. Calculations of growth in length based on this relationship were made by a nomograph for 889 angler-caught and 881 seine-caught fish. Largemouth bass reached a size of 10 inches in 3 to 4 years. Age-groups IV and V dominated the catches.

The total population of largemouth bass was estimated by the mark and recapture technique to include 21,980 fish over 6 inches long. The validity of this estimate was confirmed independently by DeLury's method involving a time series of catch-effort statistics. The estimated population amounted to 55.5 individuals or 33.3 pounds per acre, a figure similar to most reported for other stocks. Angling mortality was estimated at 12 percent and total mortality at 24 percent. (Auth. abst.)

1392. DeRoche, Stuart E. and Lyndon H. Bond. 1957. THE LAKE TROUT OF COLD STREAM POND, ENFIELD, MAINE. Transactions of The American Fisheries Society Eighty-fifty Annual Meeting, 1955, pp. 257-270.

Lake trout, Cristivomer namaycush (Walbaum), were netted in Cold Stream Pond, Enfield, Maine, during the spawning seasons of 1951, 1952, 1953. The fish were weighed, measured and tagged with monel-metal jaw tags, and scale samples were secured for age determinations. A creel census, conducted during the fishing seasons of 1952 and 1953, contributed additional age and growth information and tag recoveries.

Two hundred ten lake trout were tagged at the Webb Cove spawning area in October 1951, and 266 in the same area in October 1952. During the netting operations of 1952, 357 lake trout were taken including 91 fish tagged from the 1951 spawning population. In October 1953, similar netting operations yielded a catch of 233 fish including 40 tagged fish from the 1951 spawning population and 57 tagged fish from the 1952 spawning population. Recovery of tagged fish showed lake-wide distribution of the Webb Cove spawning population. Unsuccessful attempts to gillnet spawning fish on other suitable spawning areas support the assumption that the majority of lake trout in Cold Stream Pond utilize Webb Cove for spawning.

Four hundred fifteen lake trout were creeled during the fishing season of 1952: 36 were recaptures of fish tagged in 1951. Four hundred eighty-nine lake trout creeled in 1953 included 125 tagged

fish: 35 and 90 recaptures were tag recoveries from the 1951 and 1952 spawning populations respectively.

The total length of the spawning fish were 15.7 to 36.5 inches. Most of the spawning migrations in the 3-year study period were made up of fish with total lengths of 18.1 to 20.0 inches in age groups VI and VII. Only 1 fish with a total length less than 16.3 inches and 32 fish less than 17.1 inches were taken in the 3-year period.

The majority of the creeled fish in 1952 and 1953 were included in a total-length range of 17.1 to 19.0 inches in age groups V, VI, and VII. About 30 percent of the total number of fish creeled in 1952 and 1953 were immature. A length regulation of 14 inches controls the minimum size of fish that anglers take.

Male lake trout in Cold Stream Pond mature at age V (17.2 inches) and females at age VI (18.1 inches). One and 2-year growth increment curves show a definite retardation of growth as a result of jaw tags. In some instances annuli were not laid down in the 1- and 2-year periods that tagged fish were at large.

A high rate of exploitation is indicated by creel census data. Population estimates revealed that fishing success depends on a relatively small population of mature fish. (Auth. abst.)

1393. Witt, Arthur, Jr. 1957. SEASONAL VARIATION IN THE INCIDENCE OF LYMPHOCYSTIS IN THE WHITE CRAPPIE FROM THE NIANGUA ARM OF THE LAKE OF THE OZARKS, MISSOURI. Transactions of The American Fisheries Society Eighty-fifth Annual Meeting, 1955, pp. 271-279.

Seasonal variation in the incidence of diseases or parasites in natural populations of fishes has not been documented. Seasonal variation in the incidence of lymphocystis in the white crappie, Pomoxis annularis, was determined from 5,906 fish collected in 1950-1951 and 1,593 fish collected during October 1952 through 1955. The incidence of the disease was greatest in July (10.7 percent), decreased in October (1.7 percent) and increased in November (6.9 percent). Over winter the incidence of the disease gradually decreased and reached a low in April (1.4 percent) after which it increased again. The tumors occurred on all parts of the body and fins but over 60 percent on the caudal fin. The disease was more prevalent in fish under 6.7 inches than in larger ones. In 1950-1951, 97 percent of the infected fish were less than 6.7 inches long. The 1949-year class was abundant during this study and its members carried the disease for a period of 3 years. The disease does not appear to be lethal to the white crappie; however, infected fish weighed 3 to 5 percent less than sound fish of the same length. Only one other fish, a walleye, was found to be infected. (Auth. abst.)

1394. Royce, William F. 1957. OBSERVATIONS ON THE SPEARFISHES OF THE CENTRAL PACIFIC. U. S. Fish and Wildlife Service, Fishery Bulletin 124, from Fishery Bulletin of the Fish and Wildlife Service, Volume 57, pp. 497-554.

The taxonomy, distribution, size, food; and spawning habits of spearfishes are considered. Observations on several hundred spearfishes caught in the central equatorial Pacific and in the Hawaiian fishery are presented, together with an extensive review of Japanese and other literature. A morphometric study shows marked variation in all diagnostic characters and allometric growth in many.

Six species are recognized: swordfish (Xiphias gladius), shortnose spearfish (Tetrapturus angustirostris), sailfish (Istiophorus orientalis), black marlin (Istiompax marlina), striped marlin (Makaira audax), and Pacific blue marlin (Makaira ampla).

All six species are shown to be fishes of the high seas of wide distribution in the Pacific, but with different centers of abundance. The swordfish and striped marlin prefer the more temperate waters, the Pacific blue marlin the equatorial region, and the black marlin the coastal areas off Asia, America, and Australia. Maximum known weights of the Pacific forms (in pounds) are as follows: Swordfish--1,061, shortnose spearfish--114, sailfish--132, black marlin--1,560, striped marlin--483, and Pacific blue marlin--1,450. All are broadly carnivorous on fish and cephalopods. The Pacific blue marlin probably spawns throughout most of the year in equatorial waters. (Auth. abst.)

1395. Ray, Sammy M. and William B. Wilson. 1957. EFFECTS OF UNIALGAL AND BACTERIA-FREE CULTURES OF GYMNODINIUM BREVIS ON FISH. Fishery Bulletin 123 from Fishery Bulletin of the U. S. Fish and Wildlife Service, Volume 57, pp. 469-496.

A series of experiments, seven with unialgal cultures and two with bacteria-free cultures, demonstrated the toxicity of Gymnodinium brevis Davis to six species of fish. Bacteria-free cultures were just as toxic as unialgal cultures. The cultures employed contained 0.6 to 4.8 million G. brevis per liter. Apparently the test fish were differentially sensitive to G. brevis cultures. In order of decreasing sensitivity, the test fish were Membras vagrans, Mugil cephalus, Fundulus grandis, Mollienisia latipinna, Fundulus similis, and Cyprin don variegatus. The lethality of bacteria-free G. brevis cultures to fish clearly indicates that this dinoflagellate is the direct cause of the mass mortalities of fish and other marine animals that are associated with G. brevis blooms in the Gulf of Mexico.

Toxicity of G. brevis cultures does not depend on the presence of the living organisms. The more toxic portion of the culture passses through a millipore membrane whereas it is retained by filter paper. Such possible lethal factors as oxygen deficiency, suffocation due to clogging of gills with masses of organisms, and bacterial growth were eliminated experimentally, thereby establishing that G. brevis produces a toxic substance(s).

Two chromogenic marine bacteria, Flavobacterium piscicida Bein and an unidentified red-

pigment-producing form from the west coast of Florida, were tested for toxicity to fish. The results of these tests are discussed. (Auth. abst.)

1396. MacGregor, John S. 1957. FECUNDITY OF THE PACIFIC SARDINE (SARDINOPS CAERULEA). U. S. Fish and Wildlife Service, Fishery Bulletin 121 from Fishery Bulletin of the Fish and Wildlife Service Volume 57, pp. 427-449.

Diameter measurements of ovarian ova were made for 587 female Pacific sardines (Sardinops caerulea) obtained from the San Pedro commercial fishery samples for the period November 10, 1945 through February 27, 1946. The number of ova present in the most advanced group of developing ova were counted for 116 sardines that contained a distinct group of such ova. The calculated number of ova present in this group increased with age, length, and weight of the fish. The fecundity-length correlation was better than the fecundity-age correlation, and the fecundity-weight correlation was better than either of these. Fecundity-length regression lines based on four different formulas and fecundity-weight regression lines based on two different formulas are compared.

Data on age and length at first maturity based on the criterion of degree of ovarian ovum development are presented. (Auth. abst.)

1397. Rounsefell, George A. 1957. FECUNDITY OF NORTH AMERICAN SALMONIDAE. U. S. Fish and Wildlife Service Fishery Bulletin 122 from Fishery Bulletin of the Fish and Wildlife Service Volume 57, pp. 451-468.

Data on fecundity of North American Salmonidae are scarce, but analysis of available material shows that use of the total number of females as a measure of reproductive potential may introduce considerable error. Fecundity varies between populations of the same species, so that data from one locality cannot be safely applied to another. Annual differences in fecundity in the same population may be caused by differences in average size, or by differences in age at maturity.

Fecundity in the sockeye does not appear to vary between fish remaining for 3 or 4 years in the lake before seaward migration, but fish spending 2 years at sea have a higher fecundity than fish of the same size spending 3 years at sea.

Data are needed to answer two questions: (1) What is the relation between egg size and egg number in the same species; and (2) Does reproductive potential depend chiefly on number of eggs or on total volume of eggs. (Auth. abst.)

1398. Bumpus, Dean F. 1957. SURFACE WATER TEMPERATURES ALONG ATLANTIC AND GULF COASTS OF THE UNITED STATES. U. S. Fish and Wildlife Service, Spec. Sci. Rept. - Fisheries No. 214, April, pp.1-153.

Available monthly and annual mean surface temperatures except for U. S. Coast and Geodetic Survey data are presented for 114 stations, from Eastport, Maine, south to Key West, Florida, and west to Port Isable, Texas.

1399. Hile, Ralph. 1957. U. S. FEDERAL FISHERY RESEARCH ON THE GREAT LAKES THROUGH 1956. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 226, October, pp. 1-46.

The present article is a revision and explanation of my earlier paper: 25 years of Federal Fishery Research on the Great Lakes. Spec. Sci. Rep.: Fish. No. 85, 1952. Two circumstances made a revision desirable at this time. First, publications since 1952 have added greatly to the literature based on Federal studies on the Great Lakes. Second, the Great Lakes Fishery Commission, established by treaty with Canada, was organized in Ottawa in April 1956 and held its first annual meeting in Ann Arbor in November 1956. The entry of the Commission on the scene marks the start of an era of further expansion and heightens interest in past activities. (Auth. abst.)

1400. Callaway, Richard J. 1957. OCEANOGRAPHIC AND METEOROLOGICAL OBSERVATIONS IN THE NORTHEAST AND CENTRAL NORTH PACIFIC, JULY--DECEMBER 1956. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 230, August, pp. 1-49.

This report lists surface meteorological, physical, and chemical observations made during three albacore fishing cruises into the northeast and central North Pacific. Data were collected aboard the research vessels John R. Manning and Charles H. Gilbert in the summer and fall of 1956. Laboratory and field procedures are described. (Auth. abst.)

1401. Dawson, C. E. 1957. STUDIES ON THE MARKING OF COMMERCIAL SHRIMP WITH BIOLOGICAL STAINS. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 231, September, pp. 1-24.

To determine the effectiveness of biological stains as marking agents for the commercial shrimp Penaeus setiferus, P. aztecus, and P. duorarum, experiments were conducted on captive shrimp held in storage tanks and aquariums supplied with circulating sea water. Some 26 stains were tested by immersion, injection, and feeding. Staining by immersion proved consistently unsuccessful. Distinctive and fast abnormal coloration has been induced by injection with Fast Green FCF (National Aniline), Niagara Sky Blue 6B, Trypan Blue, and Trypan Red. Feeding with Mullet (Mugil cephalus) previously stained with Trypan Red also results in abnormal coloration suitable for identification. The feeding technique constitutes a satisfactory method for marking shrimp under 80 mm. in length. Whether these stains will prove equally fast under natural conditions must be determined by field experiments. (Auth. abst.)

1402. Thrailkill, James R. 1957. ZOOPLANKTON VOLUMES OFF THE PACIFIC COAST, 1956. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 232, October, pp. 1-50.

Basic data on volumes of zooplankton off the Pacific coast in 1956 are given, together with haul data for all plankton hauls taken on survey cruises of the California Cooperative Oceanic Fisheries Investigations. Distribution charts showing relative areal zooplankton abundance by month are included. (Auth. abst.)

1403. Bumpus, D. F. 1957. OCEANOGRAPHIC OBSERVATIONS, 1956, EAST COAST OF THE UNITED STATES. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 233, November, pp. 1-132.

The daily water temperature and salinity observations from sixteen locations along the Atlantic seaboard during 1956 are tabulated and discussed. Diagrams of the one-third monthly means are presented. This is the first time that it has been possible to present a synoptic description of the annual cycle of temperature and salinity for the coastal waters of the United States. (Auth. abst.)

1404. Bumpus, Dean F., and C. Godfrey Day. 1957. DRIFT BOTTLE RECORDS FOR GULF OF MAINE AND GEORGES BANK, 1931-56. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 242, November, pp.1-61.

The drift-bottle data presented here are the result of extended studies by the United States Bureau of Fisheries and more recently by the United States Fish and Wildlife Service in the region of Georges Bank and the Gulf of Maine.

1405. McGary, James W., and Thomas M. Naito. 1957. WIND ATLAS OF THE NORTH PACIFIC. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 243, September, pp. 1-35.

This atlas comprises a summary of average wind speeds in the Pacific north of 30° N. latitude, and was prepared with the hope that it would aid the fishing industry in evaluating fishing conditions and potentialities in that region. The data were obtained from the current files of unpublished wind data maintained by the U. S. Weather Bureau. They represent observations made over a 60-year period by a great number of ships traversing the area.

For each month, with a few exceptions, there are 5 charts; the first 4 indicate the geographical variations of the observed wind speeds that were ≤ 20, ≤ 25, ≤ 30, and ≤ 35 knots respectively. The fifth chart gives the maximum observed wind in Beaufort scale for each 5-degree square of latitude and longitude. (Auth. abst.)

1406. Burrows, Roger E. 1957. DIVERSION OF ADULT SALMON BY AN ELECTRICAL FIELD. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 246, December, pp. 1-11.

An electrical weir consisting of a line of hanging electrodes and a submerged ground line has proved satisfactory for the diversion of adult salmon. The electrical field is created by 110-volt, single phase, 60-cycle, alternating electrical current available from most commercial sources.

The optimum operating conditions for a weir of this type require minimum stream velocity within the electrical field of 3 feet per second, minimum barrier voltage of 0.5 volts per inch, and minimum field length of 10 feet with a voltage gradient which may vary within the range of from 0.3 to 0.7 volts per inch in the effective field.

Adult salmon, once conditioned to the electrical stimulus, may be diverted from their normal migration path into an alternate route by the electrical field. With adequate water velocities and voltage gradients the electrical weir is a positive barrier to the upstream migration of adult fish. Downstream migrant salmon fingerlings pass through the weir with impunity.

The weir is generally applicable to the varying conditions encountered in salmon streams of the Pacific Coast. (Auth. abst.)

1407. Anderson, William W. and Jack W. Gehringer. 1957. PHYSICAL OCEANOGRAPHIC, BIOLOGICAL, AND CHEMICAL DATA--SOUTH ATLANTIC COAST OF THE UNITED STATES GILL CRUISE 4. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 234, December, pp. 1-192.

This is the fourth in a series of reports presenting basic data from cruises of the Theodore N. Gill in waters off the South Atlantic coast of the United States.

1408. Anderson, William W. and Jack W. Gehringer. 1957. PHYSICAL OCEANOGRAPHIC, BIOLOGICAL, AND CHEMICAL DATA--SOUTH ATLANTIC COAST OF THE UNITED STATES GILL CRUISE 3. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 210, June, pp. 1-208.

This is the third in a series of reports presenting basic data from cruises of the Theodore M. Gill in waters off the South Atlantic Coast of the United States.

1409. Iversen, Edwin S., and Howard O. Yoshida. 1957. LONGLINE AND TROLL FISHING FOR TUNA IN THE CENTRAL EQUATORIAL PACIFIC, JANUARY 1955 TO FEBRUARY 1956. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries 203, February, pp. 1-38.

The results of 9 fishing cruises to the Line Islands area by POFI vessels during March 1955 to February 1956 are discussed. The catch rates obtained by longlining indicated that the abundance of yellowfin, Neothunnus macropterus (Temminck and Schlegel), was low as compared with previous years.

Yellowfin caught by surface trolling close to the islands were smaller than the deep-swimming yellowfin caught by longlining both near the islands and in the open ocean. Longline catch rates close to the islands were generally higher than their oceanic counterparts.

Chemical sounding tubes were used to determine the depth fished by the longline. The data indicated that the deepest hooks fished greater depths at 5° to 6° N. than near 1° N. latitude. There was no significant relationship between the catch rates on the

deepest hooks and the depth of fishing.

From 1,056 yellowfin captured and tagged in the Line Islands area, there were 2 recoveries prior to September 1956, both from the same area in which they were released. (Auth. abst.)

1410. Jackson, C. F. 1957. DETOXIFICATION OF ROTENONE-TREATED WATER. Technical Circular No. 14 of the New Hampshire Fish and Game Department, pp. 1-28.

Two chemicals have been found which will detoxify rotenone and allow early restocking. These are potassium permanganate (KM_nO_4) and chlorine (Cl_2). The rotenone used in these experiments was supplied by S. B. Penick and Co. under the trade names of "noxfish" and "Pro-Noxfish". It was found that in water relatively free from organic material the amount of the KM_n0_4 or Cl_2 necessary to detoxify a given amount of rotenone was approximately the same, in terms of ppm, as the amount of the rotenone carrier used. However, in water with more or less organic material present a considerable amount of the detoxicant was used up before the rotenone was destroyed. The amount of either detoxicant necessary to clear a body of water was found to be the amount, in terms of ppm, necessary to meet the chlorine demand plus an amount equal to the ppm of the rotenone carrier used. The technique for determining the chlorine demand is well standardized. The method used in these experiments employed ortho-tolidine as an indicator.

Since Cl_2 and KM_n0_4 seem to have the same chemical reaction in regard to organic material and in detoxifying rotenone, determination of the chlorine demand can be used in determining the amount of KM_n0_4 necessary to detoxify any given body of water as well as the amount of Cl_2. Both are equally effective in terms of ppm in detoxifying rotenone, but chlorine, in the form of chlorinated lime, is more easily handled in the field than is potassium permanganate.

Both KM_n0_4 and Cl_2 disappear quickly from treated waters and the cost is about the same. Both are very unstable in dilute solutions and must be constantly checked as to strength. This is more easily accomplished with Cl_2 than with KM_n0_4. Since the amount of either detoxicant necessary to detoxify warm water lakes with much organic material is considerable, it is felt that the cost will preclude general use. However, the use of either detoxicant should prove feasible in clear, cold-water trout ponds with little organic material when it is desirable to get those ponds back into production in the shortest possible time.

The experimental fish used in working out the formula and in testing its validity were brook, rainbow, and brown trout fry and fingerlings, and salmon fingerlings. Fallfish, shiners and Fundulus were also used. (Auth. abst.)

1411. Tiemeier, Otto W. and James B. Elder. 1957. LIMNOLOGY OF FLINT HILLS FARM PONDS FOR 1956 AND PRELIMINARY REPORT ON GROWTH STUDIES OF FISHES. Trans of the Kansas Acad. of Sci., Vol. 60, No. 4, pp. 379-392.

Those of the 18 ponds studied that were not fenced or were otherwise accessible to cattle were either intermediate or muddy in turbidity during the summer of 1956. High turbibity appears to be the limiting factor in the management of the bass-bluegill combination because of the almost impossible task of maintaining a sufficiently high bass population.

Dissolved oxygen to a depth of three feet was adequate during the summer months but at six feet and below was not adequate from the middle of June to the last week of August. Due to the difficulty in determining the amount to use and the possibility of depleting the dissolved oxygen, organic fertilizers in the form of barnyard manure should not be recommended to farmers.

These ponds were alkaline to strongly alkaline. Carbon dioxide appeared to be generally adequate for photosynthesis but not high enough to produce any harmful effects. Carbonates ranged from 0.0 to 7.5 ppm, higher than readings taken in eastern Kansas and Oklahoma, and resulted in high pH readings. Bicarbonate readings ranged from 75 to 457 ppm and are generally higher than those reported from eastern Kansas and Oklahoma.

Thermal stratification may occur before the last of May and continue less severely into October; high water temperature did not appear to be a limiting factor for fishes in Kansas ponds.

Initial growth data were for largemouth bass, bluegill, and channel catfish from 22 ponds stocked with various combinations of these species. Bass averaged 7.8 inches total length and 118 grams in age-group I, 9.2 inches and 179 grams in age-group II, and 12.2 inches and 502 grams in age-group III. Bluegill averaged 5.4 inches and 52 grams in age-group I, and 6.7 inches and 119 grams in age-group II. In uncrowded ponds channel catfish made "average" growth of about 8.7 inches and 86 grams in age-group I, 11.6 inches and 186 grams in age-group II, and 17.2 inches and 667 grams in age-group III. In some ponds "good" growth of about 11.1 inches and 174 grams in age-group I, and 17.1 inches and 742 grams in age-group II was found. (From auth. summ.)

1412. Tiemeier, Otto W. and Robert B. Moorman. 1957. LIMNOLOGICAL OBSERVATIONS ON SOME FLINT HILLS FARM PONDS. Transactions of the Kansas Acad. of Sci., Vol. 60, No. 2, pp. 167-173.

These investigations, made during the summer of 1955 when the average mean temperature was 0.9° F. above average and the rainfall 41-66 percent of average, showed that wide variations in the organic matter, phosphorus, and potash contents of pond soils may occur within a restricted area.

Dissolved oxygen content of the pond waters at six feet and below was too low most of the summer months to be conducive to good growth and reproduction of fishes. Pond waters were strongly stratified by the first of June and this condition remained until mixing occurred about mid-August. This mixing apparently was not caused by low air temperatures. Four of the 16 ponds were clear;

six intermediate in turbidity; and six muddy. (From auth. summ.)

1413. Tiemeier, Otto W. 1957. NOTES ON STUNTING AND RECOVERY OF THE CHANNEL CATFISH. Trans. of the Kansas Acad. of Sci., Vol. 60, No. 3, pp. 294-296.

Under limited predation from other fishes only a few or possibly only one successful spawn may provide more young channel catfish than a small farm pond (1.5 acres) can support. It is recommended, therefore, that ponds in Kansas should be stocked with 75 and not more than 150 fingerling channel catfish per surface acre if the average of summer turbidities is more than 100 ppm. If the water is clear, 50 to 100 fingerling channel catfish may be stocked along with 100 bass and 100 bluegill fingerlings. The channel catfish removed should be replaced with fish about 6 inches long at the rate of three fish for every two removed.

This study also showed that small fish crowded and stunted for approximately one year may recover and grow to about the same size as non-stunted fish of the same year-class when stocked in new ponds. This recovery may occur in two growing seasons or in as short a time as four months of one growing season.

1414. Neess, John C., and William W. Bunge, Jr. 1956. AN UNPUBLISHED MANUSCRIPT OF E. A. BIRGE ON THE TEMPERATURE OF LAKE MENDOTA: PART I. Reprinted from: Trans. Wis. Academy Science 45: 193-238.

This is the first part of a manuscript prepared in 1916 by Birge. It covers temperature observations and a discussion based upon them, composing together a description of the temperature cycle. In addition, certain other data still relatively rare in literature, for example changes in the thickness of the ice-layer through the winter, temperature distribution within the ice-layer and temperature inversions beneath the ice in late winter are discussed.

1415. Robins, C. Richard, and Edward C. Raney. 1957. THE SYSTEMATIC STATUS OF THE SUCKERS OF THE GENUS MOXOSTOMA FROM TEXAS, NEW MEXICO AND MEXICO. Tulane University, Tulane Studies in Zoology, Vol. 5, No. 12, pp. 291-318.

Three species of Moxostoma, congestum, austrinum and mascotae, occur in Texas, New Mexico and Mexico. They are described in detail, their morphological variation noted and their distribution and relationships discussed. All belong to the subgenus Scartomyzon of which robustum of southeastern United States is most closely related.

A new subspecies of austrinum is diagnosed and M. albidum is considered a subspecies of congestum.

M. austrinum and M. mascotae are the only members of the speciose genus, wide ranging in eastern North America, that occur on the Pacific Slope of North America. They are closely related and apparently resulted from a single transfer of fishes from Atlantic to the Pacific Slope during a past pluvial period. (Auth. abst.)

1416. Ridenhour, Richard L. 1957. NORTHERN PIKE, ESOX LUCIUS L., POPULATION OF CLEAR LAKE, IOWA. Iowa State College Journal of Science, Vol. 32, No. 1, August, pp. 1-18.

Gill nets, fyke nets, wire traps and angling were used to collect 445 pike from 1941 through 1955 in Clear Lake and adjacent Ventura Marsh. Growth in the lake was about the same as in other waters but slower during the second year than in the marsh. Females appeared to grow faster than males during the second year. Condition of pike from the lake and the marsh was nearly identical when the stocked 1953 year class was excluded from the lake estimate. This abundant stocked group remained in poor condition. Angler tag returns, highest during the first year after stocking (9.6 - 33.5 percent), were used to estimate harvest. Large catches in 1954 and 1955 (2.02 and 0.28 pike per acre, respectively) were probably the result of heavy stocking in 1953. Poor condition and handling possibly contributed to one of two mortalities particularly affecting stocked pike in the lake while high temperature probably was the cause of a mortality in the marsh. (Auth. abst.)

1417. DiCostanzo, Charles J. 1957. GROWTH OF BLUEGILL, LEPOMIS MACROCHIRUS, AND PUMPKINSEED, L. GIBBOSUS, OF CLEAR LAKE, IOWA. Iowa State College Journal of Science, Vol. 32, No. 1, August, pp. 19-34.

Age and growth determinations were made from scales of 1,215 bluegill and 336 pumpkinseed collected from 1947-54. Both species grew more rapidly in Clear Lake than in most midwest waters. Male bluegill of age groups II and III were larger than females of corresponding ages. Exceptionally strong year classes of bluegill and pumpkinseed originated in 1951, and very weak year classes in 1949. Strong bluegill year classes occurred in 1946 and 1952. Fluctuations in abundance of both species appear to be closely associated with changes in density of aquatic vegetation. Bluegill weight increased as the 3.45 power of the standard length; that of pumpkinseed, as the 3.19 power. (Auth. abst.)

1418. Hubbs, Clark. 1957. DISTRIBUTIONAL PATTERNS OF TEXAS FRESH-WATER FISHES. The Southwestern Naturalist 2 (2-3): 89-104 April-July.

Distribution patterns of most fresh-water fishes in Texas closely resemble those of terrestrial organisms, though there are 3 exceptional groups: (1) those limited by stream divides, (2) those of marine and freshwater forms meeting in fresh waters near the coast, and (3) certain species of northeastern Texas (Austroriparian) whose ranges include outliers or extensions into other biotic provinces. It is concluded that the basic factors controlling distribution patterns

of fishes are climatic and geological, these determining the properties of the water. (Auth. abst.)

1419. Neuhold, John M. and Kuo H. Lu. 1957. CREEL CENSUS METHOD. Utah State Department of Fish and Game, Publication No. 8, pgs. 36.

A method that can be used under a variety of conditions with reasonably accurate results is outlined. Step-by-step analysis of data obtained by this method is provided.

1420. Hoffman, Donald A. and Robert C. Payette. 1956. "OPERATION CARP" ON A SAN DIEGO RESERVOIR. Water and Sewage Works, July, pp. 41-47.

Hodges Reservoir, an 188.8 acre reservoir, was treated with 1375 gallons of Pro-Noxfish on January 31, 1956. By February 13, a total of 174,615 fish weighing 109 tons had been removed. Of this, 106.8 tons were carp, 1.11 tons were largemouth bass, and 1.09 tons were small crappie, bluegill, largemouth bass, and catfish. Carp averaged 16 inches and 2 pounds; bass, 20 inches and 4.5 pounds; and the small crappie, bluegill, and bass averaged 18 fish to the pound, and 2 to 5 inches in length.

As this is an irrigation and water-supply reservoir, extensive and frequent water samplings and analysis were made. Two days after treatment, the highest residual value of Pro-Noxfish was 0.2 ppm. In less than 10 days after treatment, no Pro-Noxfish could be detected in samples taken at the surface, 21-foot depth, or on the bottom. Amosphous matter and all organism counts decreased quite markedly following treatment, except for Protozoa at the surface and Protozoa and Dinoflagellates in deeper water, and water clarity increased.

1421. Underhill, James C. 1957. THE DISTRIBUTION OF MINNESOTA MINNOWS AND DARTERS IN RELATION TO PLEISTOCENE GLACIATION. University of Minnesota, Minnesota Museum of Natural History, Occasional Papers: Number 7, pp. 1-45.

One hundred seventy-six collections, made in the Minnesota River, St. Croix River, lower Mississippi River, and Missouri River basins in Minnesota during the summers 1952 through 1956, used in plotting the distribution of the minnows and darters native to the state.

Barriers to fish migrants and the time, in terms of the glacial chronology, at which these barriers began to function are discussed. An attempt is made to correlate the distribution of various groups of species with post-glacial events. Arrival of these groups is dated in terms of the Pleistocene chronology. Fifty-six of the 58 species discussed were migrants from the lower Mississippi River basin in late-glacial and post-glacial time.

Ecological factors limiting fish distribution are discussed, but it is impossible to determine at present what these limiting factors might be. It is concluded that until more detailed information on the life histories and specific requirements of certain species is obtained, an analysis of the role of ecological factors in determining a species distribution would be simply speculative. Serious pollution was encountered only once, but pollution was evident in a number of stream systems. It is suggested that faunal studies of aquatic forms be completed before pollution becomes a more serious limitation to aquatic life.

Evidence is presented indicating that at least in one instance a drainage ditch has allowed two species of minnows common to the Missouri River basin to gain access to the Mississippi River basin. It is concluded that at present drainage diversions are not of too great importance in allowing a mixing of faunas, but that they may become serious with the increased reclamation of swamp and marsh land. The lock and dam being constructed at St. Anthony Falls, Minneapolis, Minnesota, may enable species now restricted to the lower Mississippi River to invade the upper Mississippi River basin. (From auth. summ.)

1422. Alderdice, D. F. and J. R. Brett. 1957. TOXICITY OF SODIUM ARSENITE TO YOUNG CHUM SALMON. Progress Reports of the Pacific Coast Stations. Fisheries Research Board of Canada, No. 108, September, pp. 27-29.

Preliminary information is presented on toxicity to chum salmon fry of "Penite 6X", a sodium arsenite preparation used in control tests of teredo in sawlongs. This product has a typical content of 56 percent arsenic trioxide. The concentration of arsenic trioxide which will kill half of a sample of fish in 48 hours was determined to be approximately 11 ppm. One-tenth of this concentration is regarded as an approximation of a "safe" level for all durations of exposure.

1423. Hourston, A. S. and R. H. Herlinveaux. 1957. A "MASS MORTALITY" OF FISH IN ALBERNI HARBOUR, B.C. Progress Reports of the Pacific Coast Stations, No. 109, November, pp. 3-6.

Cause of this mass mortality, confined almost entirely to stickleback and shiner, Cymatogaster aggregatus, appears to have been caused by nearby dredging of cedar bark deposits; other suspect causes were eliminated on the basis of the relative location of the fish kill area and the sources of polluting effluents and knowledge of the harbor's currents. Hydrogen sulphide, an expected component of such deposits, could be smelled while the dredge was operating. As would be anticipated, water in the vicinity of the dredge slowed oxygen depletion; observations elsewhere showed normal oxygen concentrations. Solubility of hydrogen sulphide under conditions obtaining in the basin is greatly in excess of the concentration lethal to fishes.

1424. Taylor, G. T. and R. J. LeBrasseur. 1957. DISTRIBUTION, AGE, AND FOOD OF STEELHEAD TROUT (SALMO GAIRDNERI) CAUGHT IN THE NORTHEAST PACIFIC OCEAN, 1956. Progress Reports of the Pacific Coast Stations, No. 109, November, pp. 9-11.

During the course of exploratory gill-net fishing to learn about the distribution of Pacific salmon in the northeast Pacific Ocean, 32 steelhead trout were taken. They ranged in size from approximately 11 to 34.5 inches long, in age from 2 to 7 years, and in time at sea from less than one year to 4 years; most were in their fourth year of life and had gone to sea in their third year. The predominant food item both in frequency of occurrence and percentage of volume was fish, particularly greenling, Hexagrammus decagrammus. Amphipods were found in 8 stomachs and squid in 2. Euphansiids, which frequently form a large percentage of food eaten by salmon, were found only once, and then in an insignificant amount.

1425. Smith, M. W. 1957. COMPARATIVE SURVIVAL AND GROWTH OF TAGGED AND UNTAGGED BROOK TROUT. The Canadian Fish Culturist, Issue Twenty, August, pp. 1-6.

Jaw-tags on brook trout had no demonstrable effect upon survival in cool waters and when held for periods of less than one year. However, growth was retarded, presumably through interference with feeding. Growth was more retarded in ponds when the trout were held for 248 days over a winter period, than when retained 108 days in the summer season. A growth correction factor is indicated for tagged trout, but the correction will vary in magnitude with length of time and conditions under which the trout are held. Trout which have lost tags are not always recognizable from wounds caused by tagging. Fin-clipping provides identification of such fish. (Auth. summ.)

1426. Smith, S. B. 1957. SURVIVAL AND GROWTH OF WILD AND HATCHERY TROUT (SALMO GAIRDNERII) IN CORBETT LAKE, BR. COLUMBIA. The Canadian Fish Culturist, Issue 20, August, pp. 7-12.

One group of fish raised in natural ponds and another group raised in a hatchery, both from wild stock, were marked and released in Corbett Lake in 1953. This was replicated in 1954. Since both groups had similar parental backgrounds, it was to be expected that any possible differences in their reactions to the new environment should result from their histories between hatching and time of stocking as yearlings.

Data indicate that wild-reared fish grew faster than the hatchery fish both prior and subsequent to release. Whether this reflects better conditioning of the wild trout or preservation of "weaklings" under hatchery conditions cannot be determined. That they were differently conditioned is likely. There was no significant indication that unequal survival rates existed.

Though both groups were kept at the hatchery for 10 days following marking, and fed the same food to preclude possibility of bias from temperature and diet acclimation, it was evident that members of each group either aggregated in such a way that they were susceptible to capture as schools, or tended to exclude interchange of members between schools. The results of the experiment suggest that where survival, growth, and behavior of wild-fish of any species are being assessed, either by comparison with hatchery-raised fish or by handling of wild stocks, an awareness of possible conditioning of young fish during early life or at time of handling is of considerable importance.

1427. Black, Edgar C., and Isadore Barrett. 1957. INCREASE IN LEVELS OF LACTIC ACID IN THE BLOOD OF CUTTHROAT AND STEELHEAD TROUT FOLLOWING HANDLING AND LIVE TRANSPORTATION. The Canadian Fish Culturist, Issue Twenty, August, pp. 13-24.

Alterations in the blood levels of lactic acid were investigated in hatchery raised cutthroat and steelhead trout in the following conditions: 1. after transferring from outside ponds to troughs inside the hatchery 60 yards = 54.9 metres away; 2. sham transportation run for two hours in tank truck; and 3. holding cutthroat for 40 hours, steelhead for 16 hours in hatchery troughs before transportation run of 2 hours 50 minutes. The following results were noted: (1) Significant increases in blood lactic acid occurred in both species as a result of minimal handling, i. e. in transporting the fish from outside ponds to inside hatchery troughs. (2) Very significant increase in blood levels of lactic acid following sham transportation run for 2 hours in a tank truck. The levels were higher in both species than those observed for lake trout and Kamploops trout in 1955. (3) Storage of cutthroat for 40 hours resulted in significant lowering of blood level of lactic acid (range 0.8 _ 17.5 mg.%) following transportation run of 2 hours and 50 minutes.

Storage of steelhead trout for 16 hours before the same transportation run of 2 hours and 50 minutes resulted also in a lower blood level of lactic acid (range 9.5 _ 88 mg.%)

It is concluded that even minimal handling caused significant increase in muscular activity both for cutthroat and steelhead trout, that handling and live transportation for 2 hours caused a very significant degree of muscular activity, and that previous history of activity may result in lowered blood levels of lactic acid following a second phase of activity. It is possible that this phenomenon may be due to a very slow rate of resynthesis of muscle glycogen. It is possible that if the muscle glycogen is depleted and takes a long time to be resynthesized, this may have some bearing in the conditioning of fish by exercise previous to liberation. (Auth. summ.)

1428. Sequin, Richard L. 1957. MANAGEMENT, FISHING RESULTS AND GROWTH OF SPECKLED TROUT (SALVELINUS FONTINALIS) IN BALDWIN POND, STANSTEAD COUNTY, QUE. The Canadian Fish Culturist, Issue Twenty, August, pp. 29-37.

In the fall of 1953, 67-acre Baldwin Pond was reclaimed. In 1954, 20,000 yearling and 5,000 fingerling brook trout were planted; this was followed in the Spring of 1955, with a planting of 2500 additional yearlings.

A creel census covering the fishing season from May through September 1955, showed that 1303 anglers fished for 3652 hours catching 4691 trout for an average of 3.6 trout per angler and 1.28 trout per hour. Actually, almost half, 2,759, of the season's

catch was taken on the opening day by 30 percent of the anglers. Still fishing, the preferred method of the majority, proved very efficacious; on opening day 2.04 trout per hour were taken by this method.

1429. Elson, P. F. 1957. THE IMPORTANCE OF SIZE IN THE CHANGE FROM PARR TO SMOLT IN ATLANTIC SALMON. The Canadian Fish Culturist, Issue Twenty-one, December, pp. 1-6.

Evidence is presented to show that, as a general rule, parr which have reached or exceeded a certain size towards the end of one growing season are likely to become smolts at the next season of smolt descent. In fact, the concept of a size prerequisite appears to have more fundamental significance with respect to change from parr to smolt than either age or size at the actual time of transformation. The hypothesis definitely does not specify that young Atlantic salmon become smolts as soon as they reach a length of 10 cm., but rather that they transform after reaching this length in the smolt-running season immediately following. Growth of parr is variable. Those which have nearly but not quite reached the 10-cm. length at the end of a summer will, if they grow fast, reach a much greater length, say 14 to 16 cm., at the end of the following summer, and make big smolts. Those which have just barely attained the required 10 cm. size at the right time will, if slow-growing, make little smolts, perhaps only about 12 cm. long. The 10-cm. hypothesis thus takes account of the extremely variable size-range of smolts from many types of rivers. While not precise for individual fish, this 10-cm hypothesis provides a useful and justifiable rule of thumb for gauging annual smolt production from streams.

Canadian investigators of Atlantic salmon at present classify young salmon as "small" parr, those which will probably spend one or more additional years in river growth, and "large" or "pre-smolt" parr, those which are likely to descend as smolts during the next seaward migration. The arbitrary division between the two groups of parr has been chosen at a total length of 10 cm. or 4 in. reached during the latter part of a year's growth. Use of the hypothesis should contribute to effective planning of salmon-rearing programs for hatcheries, if special purposes can be served by planting larger fish. (From auth. summ.)

1430. Elson, P. F. 1957. USING HATCHERY-REARED ATLANTIC SALMON TO BEST ADVANTAGE. The Canadian Fish Culturist, Issue 21, December, pp. 7-17.

This article presents in convenient brief form seven items for consideration of Atlantic salmon biologists. These cover the control of mergansers and kingfishers, the numbers of fish to plant, the amount of dispersal considered desirable at planting, the size of fish to plant, the selection of stream bottom for planting sites, eel predation, and the return of adults.

1431. Elson, P. F. 1957. NUMBER OF SALMON NEEDED TO MAINTAIN STOCKS. The Canadian Fish Culturist, Issue 21, December, pp. 19-23.

This interim report calculates that the potential egg deposition rate should be 200 per 100 square yards, or about 44 pounds of female salmon per mile of 10-yard-wide stream, in order to provide the previously determined production of 10 large parr per 100 square yards of stream bottom. Analysis of data so far collected on four maritime streams substantiates this calculation, that between 40 and 50 pounds of adult females per mile of stream 10 yards wide are required to maintain stocks. Natural spawning appears to have been sufficient; in fact it is hard to see how these streams under normal conditions could use to advantage additional brood stock or hatchery products.

1432. Elson, P. F. 1957. THE ROLE OF HATCHERIES IN ASSURING MARITIME STOCKS OF ATLANTIC SALMON. The Canadian Fish Culturist, Issue 21, December, pp. 25-32.

Hatchery distribution of Atlantic salmon from 1907 through 1947 has had no influence on size of commercial landings. This is not surprising in view of the previously reported lack of any clear-cut relationship between the amount of parent salmon caught in one year and the amount of their offspring caught six years later; the conclusion, that naturally produced increases of young often do not show up in later catches. But this does not mean that hatcheries are of no value.

Tagging and recapture studies, and estimates of total sport and commercial catches, place the total salmon stock in the Maritime region at 1,000,000 fish, ranging from 500,000 to 1,500,000 in any one year. Assuming 50 percent survival to spawning and utilizing available fecundity and fingerling and smolt survival data to determine natural contribution, the potential hatchery contribution of 15,000,000 fingerlings a year seems to be one-fifth to one-fourth of the present stock. This is a valuable contribution, 500,000 pounds, but difficult to identify in catch statistics which have varied from under 1,000,000 to over 5,000,000 pounds a year. Hatchery contributions also ensure against extinction of stock, if and when this should threaten.

1433. Hubbs, Clark and Victor G. Springer. 1957. A REVISION OF THE GAMBUSIA NOBILIS SPECIES GROUP, WITH DESCRIPTIONS OF THREE NEW SPECIES, AND NOTES ON THEIR VARIATION, ECOLOGY, AND EVOLUTION. The Texas Journal of Science, Vol. IX, No. 3, September, pp. 279-327.

The members of the Gambusia nobilis species group are defined; three of the species, G. geiseri, G. hurtadoi, and G. alvarezi, are described as new. Five of the six species have been reared in the laboratory and maintain morphologic distinctions used. Laboratory-raised specimens are shown to have great morphometric differences from wild-caught individuals of the same populations. Known ranges are given for all species. All six species are shown to be abundant in clear spring-fed habitats. Only one, G. senilis, occurs frequently in other

habitats. One of the springs is shown to have annual thermal variation. The dorsal ray number correlates with the temperature in two species. Three males, either sex reversed or delayed in transformation, have gonopodia similar to those of other related species and genera. The species are suspected to have evolved while isolated geographically. This isolation is believed to be due to drought and competition with Gambusia affinis. (From auth. summ.)

1434. Rawson, D. S. 1957. LIMNOLOGY AND FISHERIES OF FIVE LAKES IN THE UPPER CHURCHILL DRAINAGE, SASKATCHEWAN. Fish. Rept. No. 2 of the Fish. Br., Dept. of Natural Resources, Saskatchewan, 61 pgs.

Five large lakes totalling 750 square miles in the Upper Churchill drainage were studied. One has sustained a heavy fish production for a long time; the others are reported to have suffered a drastic reduction. They lie at an altitude of 1381 to 1382 feet. Their maximum depths range from 31 to 89 feet, and have mean depths of 17 to 45 feet. Water temperatures are rather high with bottom temperatures usually just a few degrees below those at the surface; highest mean temperatures range from 61 to 69.5° F. They show almost no thermal stratification. These are whitefish rather than lake trout lakes.

The large fish include the usual combination of whitefish, ciscoes, suckers, pike, perch, and pickerel. Lake trout are found in only one small area in one lake. Spottail minnows, ninespine sticklebacks and trout-perch dominate the small fish. Ciscoes are abundant in all of the lakes. The whitefish grow at a "normal" rate, while pike and pickerel grow rather slowly.

Food studies showed that whitefish feed mainly on chironomid larvae, sphaeriids, and amphipods; white suckers and perch had much the same diet; and ciscoes took nearly 90 percent plankton. Pickerel, pike, and burbot ate a considerable variety of other fish, also some amphipods, and chironomids.

Commercial production averages about 1,850,000 pounds per year for the five lakes, with one lake contributing nearly half of this. Production during the past five years compared with that in the previous ten, shows no cause for alarm. Production has increased in four of the five lakes and in the fifth a small drop of 15 percent is outweighed many times by the increased catch of fish for mink feed.

Management of the commercial fishery in these lakes is accomplished by setting suitable annual limits based on past experience and the results of biological investigations. The present quotas for the lakes have been reviewed in the light of recent findings. It is not suggested that any of the limits be reduced and some of them could be increased moderately. Clear evidence has been obtained of the biological and physical conditions which make possible the very high rate of production (nearly 7 pounds per acre and one million pounds per year) in the most productive lake.

1435. White, H. C. 1957. FOOD AND NATURAL HISTORY OF MERGANSERS ON SALMON WATERS IN THE MARITIME PROVINCES OF CANADA. Fisheries Research Board of Canada, Bulletin No. 116, pp. 1-63.

Of the merganser stomachs collected yearly from 1932 to 1954, 949 contained identifiable food organisms. Of these, 887 were from American mergansers, 60 from red-breasted mergansers, and 2 from hooded mergansers.

Young salmon composed from 5 to 91 percent of all fish eaten, varying considerably within and between drainages studies, and were found in 45 to 96 percent of the stomachs examined from the various areas. Even in the Atlantic Nova Scotia and Bay of Fundy drainage areas where salmon made up as little as 5 percent of the fish food items, 45 to 62 percent of the mergansers had eaten salmon, strongly suggesting that salmon are a preferred food of American mergansers. This must be qualified by the fact that mergansers which feed by sight need clear water which is also typical salmon habitat.

Studies of captive mergansers indicated that 72 pounds of fish are needed to raise a merganser. This, combined with the finding that 46 percent of fish-food items eaten by Miramichi River mergansers were salmon, and utilizing an average weight of 1/3 ounce per salmon parr, provides an estimate that 1,584 salmon parr are eaten by a merganser to attain full growth. The 1,200 birds shot on the Miramichi River during merganser control operations in 1954 consequently represented an annual consumption of over 1,900,000 salmon parr. This is calculated to represent more than two-thirds the annual smolt production of the river.

Any beneficial effect of buffer-fish, minnows and suckers, would only be active if such fish were more easily caught than salmon or were preferred food items. No evidence is available to support either contention; in fact, the reverse may be true.

The merganser is one of the most important predators on salmon in the area studied. It is shown that control of merganser populations, carried out by carefully trained crews, can maintain the balance of nature and keep salmon at maximum production levels.

1436. Davis, William S. 1957. OVA PRODUCTION OF AMERICAN SHAD IN ATLANTIC COAST RIVERS. U. S. Fish and Wildlife Service, Research Report 49 5 pgs.

The number of ova produced by American shad (Alosa sapidissima) based on samples of five fish from each of six Atlantic coast rivers was found to range from 209,000 to 616,000 ova per year. Hudson River shad produced fewer ova by size and St. Johns River shad produced more ova by size than did shad from the other four rivers. Statistical evidence is presented to show that the six ovarian samples per fish used to estimate total ova production can be reduced without impairing the accuracy of the total ova production estimate. (Auth. abst.)

1437. Robertson, O. H., 1958. ACCELERATED DEVELOPMENT OF TESTIS AFTER UNILATERAL

GONADECTOMY, WITH OBSERVATIONS ON NORMAL TESTIS OF RAINBOW TROUT. U. S. Fish and Wildlife Service, Fishery Bulletin 127, from Fishery Bulletin Volume 58, pp. 9-30.

An experimental study was made of the growth and development of the testes in rainbow trout employing unilateral gonadectomy to stimulate spermatogenesis in the infantile gonad. It was found that the remaining testis of trout more than a year old increased rapidly in weight and within a period of 6 weeks had grown to 3 or 4 times the size of a single testis in the control fish. Histological studies showed that the cellular changes occurring in these experimentally stimulated testes were identical with those found in the testes of trout maturing normally. These are described in detail. Failure of young trout to exhibit growth of the testis remaining after unilateral gonadectomy was found to be due not to lack of stimulability of the juvenile testis but most probably to the non-reactivity of the pituitary at this age. Good nutrition was observed to favor, while starvation suppressed, testis growth. (Auth. abst.)

1438. Snieszko, S. F., and G. L. Bullock. 1957. TREATMENT OF SULFONAMIDE-RESISTANT FURUNCULOSIS IN TROUT AND DETERMINATION OF DRUG SENSITIVITY. Fishery Bulletin 125 from Fishery Bulletin of the Fish and Wildlife Service, Volume 57, pp. 555-564.

Treatment of furunculosis with sulfonamides was unsuccessful when the outbreak was caused by sulfonamide-resistant variants of the pathogen. The pathogen was sensitive to chloramphenicol and treatment with this antibiotic resulted in greatly reduced mortalities. Losses were also greatly affected by the strain-specific resistance or susceptibility of the experimental brook trout to furunculosis.

Sensitivity or resistance of Aeromonas salmonicida to sulfonamides and antibiotics was determined in vitro, using various liquid and solid bacteriological media. A simple method for the determination in vitro of sulfonamide- and antibiotic-sensitivity of A. salmonicida is described for field use. A revised method of treatment of furunculosis is also outlined. (Auth.) abst.)

1439. Milne, D. J. 1957. RECENT BRITISH COLUMBIA SPRING AND COHO SALMON TAGGING EXPERIMENTS, AND A COMPARISON WITH THOSE CONDUCTED FROM 1925 to 1930. The Fisheries Research Board of Canada, Bulletin No. 113, pp. 1-56.

From 1949 to 1952 a total of 1,222 spring (chinook) salmon and 2,190 coho salmon were tagged off the coast of British Columbia to demonstrate the ocean migrations and the rivers of origin of fish exploited by the offshore troll fishery. These represent the Canadian part of a coastwide tagging program carried out from Alaska to California through the coordination of the Paciric Marine Fisheries Commission. Most spring salmon were on long spawning migrations, travelling in a southeasterly direction along the continental shelf towards the larger rivers, such as the Columbia and Fraser. Off the southwestern part of Vancouver Island many small immature fish were tagged and recovered from various directions during the next two years. All coho salmon were on shorter spawning migrations, travelling in many directions from offshore waters towards the numerous small coastal streams.

Similar experiments carried out from 1925 to 1930 involved 6,457 spring salmon and 7,126 coho salmon. A comparison between the experiments conducted off the west coast of Vancouver Island in the two periods revealed the following: For spring salmon, the percentages returned were the same (12.9). However small fish appear to provide fewer returns than large fish and more small fish were caught and tagged in recent years. Also more of the tagged fish were recaptured in the recent period off British Columbia (71% compared to 16%) and in the Fraser River (12% compared to 5%) while less were caught in United States waters (29% compared to 80%) and in the Columbia River (16% compared to 60%). This implies that the trollers are now fishing more intensively near the tagging areas and on stocks which spawn in British Columbia rivers rather than on the Columbia River stocks which have decreased greatly in size and importance in recent years. For coho salmon, the percentages returned were higher recently (9.2 compared to 6.1) owing to an increase in the fishing intensity, particularly in United States waters.

The outside troll fishery of British Columbia has been shown to catch a mixture of fish from many streams along the Pacific coast. For this reason certain conservation measures for spring and coho salmon should be considered on an international basis. (Auth. abst.)

1440. Zicker, E. L., K. C. Berger, and A. D. Hasler. 1956. PHOSPHORUS RELEASE FROM BOG LAKE MUDS. Limnology and Oceanography, Vol. 1, No. 4, October, pp. 296-303.

The paper reports the results of some laboratory investigations concerning the mud-water phosphorus relationship of some Northern Wisconsin and Upper Michigan bog lake muds as influenced by lime, acid, and mechanical agitation.

Calcium carbonate added to the water phase of mud-water-systems reduced the amount of soluble phosphorus from 8.0 to 0.8 parts per billion. The lime formed a thin crust at the mud-water interface, while the original pH of the bottom material prevailed at a depth of one-fourth inch below the mud surface. Agitation of the mud cores by stirring resulted in complete lime penetration throughout a three-inch core.

Experimental apparatus in which it is possible to obtain a 12° C temperature differential for stratifying water is described.

Radioactive ordinary superphosphate fertilizer was placed at various depths below the mud surface, and the percentage as well as the amount of

phosphorus released to the water was indicated to be very small with virtually no phosphorus released from depths greater than one-fourth inch below the mud surface. Agitation by stirring of the muds resulted in approximately twice the concentrations of soluble phosphorus in the water phase of the agitated systems as compared to the undisturbed systems. The most effective means of releasing fertilizer phosphorus placed one-fourth inch below the mud surface was found to be the acidification of previously limed mud-water systems.

The mechanism of phosphorus suppression by the addition of calcium compounds to mud water systems is suggested to be adsorption of phosphate ions onto the surface of the calcium particles in a similar manner as that described by Boischot et al. (Auth. abst.)

1441. Forney, John L. 1957. RAISING BAIT FISH AND CRAYFISH IN NEW YORK PONDS. Cornell Extension Bulletin No. 986, New York State College of Agriculture, pgs. 1-30.

Tests conducted in 90 ponds demonstrated that the golden shiner, fathead minnow and white sucker can be raised successfully in New York in properly designed ponds. The publication covers design of bait ponds; procedures for raising these three species and their harvesting; the raising of crayfish; the elimination of undesirable fish; the regulations concerned with construction of ponds, stocking of fish, sale of fish, etc.; and financial considerations.

1442. Hubbs, Clark and Kirk Strawn. 1957. THE EFFECTS OF LIGHT AND TEMPERATURE ON THE FECUNDITY OF THE GREENTHROAT DARTER, ETHEOSTOMA LEPIDUM. Ecology, Vol. 38, No. 4, October, pp. 596-602.

This study has shown that the reproductive rate is controlled by temperature and the condition of the fish. In nature, mature fish are not ripe at extreme temperatures at seasons when nearby populations are in breeding condition at more favorable temperatures. Light duration and intensity do not appear to affect fecundity of greenthroat darters. No consistent differences were noted in laboratory experiments between fish exposed to different light durations held at approximately the same temperature. The fecundity varied with temperature in the experiments. The optimal temperature for egg production appears to be between 20 and 23° C. One female produced eggs in the laboratory at regular intervals for at least 251 days and possibly for as long as sixteen months. (Auth. summ.)

1443. Miller, George C. 1957. MARINE FISHERY DEVELOPMENT IN LIBERIA, 1952-54, U. S. Fish and Wildlife Service, Fishery Leaflet 440, September, 41 pgs.

This report on the development of marine fisheries in Liberia under the program of the Foreign Operations Administration is intended to describe the condition of the fisheries of Liberia in 1952, to outline briefly the principal activities of the marine-fishery technician, and to indicate in a general way the lines of development and the progress made during the period 1952-54. The survey and investigation, undertaken at the request of the Liberian Government, was supervised during the early part of the work by the Office of Foreign Activities of the Fish and Wildlife Service of the Department of the Interior and during the later part, by the Technical Cooperation Administration. (Auth. intro.)

1444. Pickford, Grace E. and Bernard Kosto. 1957. HORMONAL INDUCTION OF MELANOGENESIS IN HYPOPHYSECTOMIZED KILLIFISH (FUNDULUS HETEROCLITUS). Endrocrinology, Vol. 61, No. 2, August, pp-177-196.

Experiments were made on hypophysectomized Fundulus heteroclitus injected thrice weekly for one month at 20° C. Alpha corticotropin had no effect on pigmentation at doses of 1 μg. or 10 μg. /gm. wt. / injection. Highly purified prolactin (35 I.U. /mg.), free from intermedin and ACTH, stimulated melanin synthesis in already developed melanophores at doses of 1 μg. or 10 μg. /gm. wt. / injection, but no new melanophores were formed. Highly purified intermedin, ACTH-free, caused little or no increase in melanin synthesis but promoted the proliferation of new melanophores which spread over the belly. The threshold dose for this response was ca. 100 MSH units/gm. wt. / injection; a maximal response was elicited by ca. 1000 MSH units. The response to a low dose of intermedin was potentiated by simultaneous administration of prolactin. Illumination promoted the proliferation of malanophores, in response to combined treatment with intermedin + prolactin. Illumination promoted the proliferation of melanophores, in response to combined treatment with intermedin + prolactin, but had no significant effect on the increased production of melanin. New melanophores differentiated from macrophage-like propigment cells already present in the dermis. (Auth. summ.)

1445. Schaefer, Milner B. 1957. SOME CONSIDERATIONS OF POPULATION DYNAMICS AND ECONOMICS IN RELATION TO THE MANAGEMENT OF THE COMMERCIAL MARINE FISHERIES. Jour. Fish. Res. Bd. of Canada, Vol. 14, No. 5, September, pp. 669-681.

Population dynamics of commercial fish stocks and the economics of commercial fishing are discussed. Fundamental aspects of self-regulating resources, an economic model of a fishery, and social and political considerations are covered. The improbability of agreement among nations for the joint management of high-seas fisheries on an economic yield basis and the need for establishing at least a limited property right in the fishery, is emphasized. Free access to a fishery by all citizens and obtaining the possible economic yield are mutually exclusive.

1446. Frick, Harold C. 1957. THE OPTIMUM LEVEL OF FISHERIES EXPLOITATION. Jour. Fish. Res. Bd of Canada, Vol. 14, No. 5, September, pp. 683-686.

A dissertation on the complexities involved in

determining the optimum level of exploitation. A social welfare optimum has different regional, national, and international aspects; maximum economic yield does not always coincide with this optimum.

1447. Miller, Richard B. 1957. PERMANENCE AND SIZE OF HOME TERRITORY IN STREAM-DWELLING CUTTHROAT TROUT. Jour Fish. Res. Bd. of Canada, Vol. 14, No. 5, September, pp. 687-691.

Gorge Creek is a small cutthroat trout stream in Alberta on the eastern slopes of the Rocky Mountains. In the summer of 1954, 98 trout were tagged with Petersen tags, weighed and returned to the pool of capture. In the same summer and in the next two, 58 of these trout were recaptured, some several times, so that, altogether, 83 records were obtained. Twenty-three records are of the first year, 35 from the second and 25 from the third.

Sixty-seven percent of the recaptures were made in the original pool or less than 200 yards from it. Of the remaining 33%, one fish had moved 1.5 miles upstream and remained there. The others had all drifted downstream. The drifters were smaller fish than those that stayed home, and they either lost weight or gained at rates considerably below normal. It is suggested these fish had been injured by the tags. The general conclusion is that each cutthroat trout of Gorge Creek has a home territory not over twenty yards long and that the whole life is spent in it. (Auth. abst.)

1448. Squires, H. J. 1957. SQUID, ILLEX ILLECEBROSUS (LeSUEUR), IN THE NEWFOUNDLAND FISHING AREA. Jour. Fish. Res. Bd. of Canada, Vol. 14, No. 5, pp. 693-728.

Data from incidental trawl catches of squid by the research vessel, Investigator II, showed that distribution of Illex in the Newfoundland area was marked by a seasonal migration over the Grand Banks in early May, and northward and westward as far as Hamilton Inlet, Labrador, and inshore Newfoundland by August. Earliest occurrence inshore was in late June, earlier in recent years than heretofore. Comparative numbers taken on the Grand Bank in May and June in different years appear to indicate the abundance to arrive inshore later in each year. Annual abundance inshore varies, but years of scarcity do not appear to be cyclical nor need they indicate year-class failure. A correlation between abundance inshore and weather conditions may exist. Measurements during the inshore migration showed a regular and large increment of length and weight monthly until October. Female squid reached a greater size than males in the late season but weighed less than males at the same mantle length. Fin length was 35 to 40% of mantle length in Illex, compared with 53 to 63% in Loligo pealii. Many males taken in the late season had reached sexual maturity, but only two females captured on the Grand Bank in May, 1953, had reached equivalent maturity: these females had greatly enlarged nidamental glands.

Small squid taken offshore in 1946 to 1952 had been feeding mostly on euphausids, but larger squid taken inshore had been feeding mostly on fish. In females 44% of the stomachs were empty, and in males, 50%

Parasites found were tapeworm plerocercoids of Phyllobothrium sp and Dinobothrium (sensu lato) sp., and occasionally a small larval nematode. (Auth. abst.)

1449. Mills, D. H. 1957. HERRING GULLS AND COMMON TERNS AS POSSIBLE PREDATORS OF LOBSTER LARVAE. Jour. Fish. Res. Bd. of Canada. Vol. 14, No. 5, September, pp. 729-730.

Herring gulls (Larus argentatus) and common terns (Sterna hirundo) were collected in the southern Gulf of St. Lawrence when lobster larvae were abundant. No lobster larvae were found in 36 herring gull stomachs and only one in 15 common tern stomachs. (Auth. abst.)

1450. Bailey, W. B. 1957. OCEANOGRAPHIC FEATURES OF THE CANADIAN ARCHIPELAGO. Jour. Fish. Res. Bd. of Canada, Vol. 14, No. 5, September, pp. 731-769.

Oceanographic data collected during the first cruise of H. M. C. S. Labrador to the Canadian Arctic in August and September 1954 permit comparisons of the vertical temperature and salinity structures in Baffin Bay, the Canadian Archipelago and the Arctic Ocean. From a comparison of the temperature-salinity characteristics of the waters in the Arctic Ocean (Beaufort Sea) with those in Baffin Bay, it is found that: (a) the surface waters of the Arctic Ocean are much less saline than those in Baffin Bay, but minimum temperatures are the same (-1.8°C.), (b) the waters of the upper 200 m. in Baffin Bay are denser than those found at corresponding depths in the Arctic Ocean, (c) below 200 m., Arctic waters are the denser, and below 500 m. they are denser than any waters found in Baffin Bay, and (d) waters found at 250 m. in the Beaufort Sea, at 500 m. in Smith Sound, and at 1250 m. in central Baffin Bay, have identical temperature and salinity characteristics (-0.3°C., 34.4 °/oo).

In addition the data permitted limited investigations into the effect of drifting ice floes on the vertical temperature structure of the water, the origin of the "north water", long-term variations in the oceanographic conditions in Baffin Bay, and dynamic calculations of currents and volume transports of the waters through the channels leading into Baffin Bay. (Auth. abst.)

1451. Alderdice, D. F. and J. R. Brett. 1957. SOME EFFECTS OF KRAFT MILL EFFLUENT ON YOUNG PACIFIC SALMON. Jour. Fish. Res. Bd. of Canada, Vol. 14, No. 5, September, pp. 783-795.

Sockeye salmon underyearlings (Oncorhynchus nerka) were exposed to various concentrations of full-bleach kraft mill effluent under experimental conditions simulating those anticipated in the estuary of the Somass River at the head of Alberni Inlet, B. C. An anticipated expanded production of a kraft pulp

mill discharging effluent into this area was regarded as a potential source of pollution which could influence survival of young salmon migrating into and through the estuary. A 4.8% concentration of effluent by volume in sea-water of 20 °/oo salinity at 17.8° C. was a limiting concentration for toxicity, below which survival was complete and independent of length of exposure. However, when oxygen requirements for respiration were considered and were compared with net oxygen availability after effluent oxidation in the area, the interaction of toxicity of the effluent and lowered oxygen availability suggests that the limiting concentration of effluent in this particular case be lowered from 4.8 to 2.5% effluent. (Auth. abst.)

1452. DeLury, D. B. 1958. THE ESTIMATION OF POPULATION SIZE BY A MARKING AND RECAPTURE PROCEDURE. Jour. Fish. Res. Bd. of Canada, Vol. 15, No. 1, January, pp. 19-25.

The Schumacher and Schnabel estimates of population size are compared and reasons are given for preferring the Schumacher formula. This formula is extended to permit mortality and recruitment in the population. Confidence limits are provided according to standard regression theory. (Auth. abst.)

1453. Miller, Richard B. 1957. THE ROLE OF COMPETITION IN THE MORTALITY OF HATCHERY TROUT. Jour. Fish. Res. Bd. of Canada, Vol. 15, No. 1, January, pp. 27-45.

The literature on the survival of hatchery-reared trout after release in streams is reviewed and the conclusion is reached that survival is poor in lakes and streams where a resident trout population already exists. In streams the deaths of planted trout occur very soon after their release and have been referred to as "delayed mortality". However, a comparison of survivals after planting in occupied and non-occupied streams shows that many of the deaths are not attributable to hatchery-background or transportation methods, but largely to some aspect of competition with resident trout. Some investigations which have sought to measure the relative survivability of wild and hatchery trout have not used resident wild trout and thus a crucial aspect of the competition has been omitted. Investigations at the Alberta Biological Station test stream, Gorge Creek, are described; in these a significant difference in blood lactic acid levels was found between hatchery trout with and without competition from resident trout. A tentative role is assigned competition as follows: introduced trout must compete for niches and for food. In the early stages of this competition they are continuously exercising; they exhaust stores of some metabolite and die either of acidosis or starvation. (Auth. abst.)

1454. Vladykov, Vadim D. and W. I. Follett. 1958. REDESCRIPTION OF LAMPETRA AYRESII (Gunther) OF WESTERN NORTH AMERICA, A SPECIES OF LAMPREY (PETROMYZONTIDAE) DISTINCT FROM LAMPETRA FLUVIATILIS (LINNAEUS) OF EUROPE. Jour. Fish. Res. Bd. of Canada, Vol. 15, No. 1, January, pp. 47-77.

Lampetra ayresii (Gunther), a species of parasitic river lamprey endemic to western North America, is redescribed on the basis of material from off the Skeena River, British Columbia, to San Francisco Bay, California. A neotype is designated. Transformed specimens differ from those of the European Lampetra fluviatilis (linnaeus) in having a larger eye, a longer prebranchial and a shorter branchial region, and possibly a lower second dorsal fin, an acute rather than an obtuse caudal fin, a higher average number of trunk myomeres, and an area of dark pigment on the caudal fin. Ammocoetes differ from those of Lampetra fluviatilis principally in having a higher number of myomeres, a dark caudal spot (which distinguishes them also from ammocoetes of Lampetra planeri (Bloch), the nonparasitic brook lamprey), and an absence of dark pigment on most parts of the head and on the precursor of the tongue. Specimens from Oregon are recorded for the first time. Specimens from Mill Creek, Tehama County, California, show that this species ascends the Sacramento River farther than previous records indicated. An annotated synonymy is included. Lampetra ayresii is indicated as distinct from Ammocoetes cibarius Girard, which is regarded as identical with Entosphenus tridentatus (Richardson). Lampetra ayresii and Lampetra fluviatilis are illustrated by a number of original drawings and photographs. (Auth. abst.)

1455. Trites, R. W. and R. E. Banks. 1958. CIRCULATION OF THE SCOTIAN SHELF AS INDICATED BY DRIFT BOTTLES. Jour. Fish. Res. Bd. of Canada, Vol. 15, No. 1, January, pp. 79-89.

The surface circulation on the Scotian Shelf has been investigated by means of 827 drift bottles released by the Naval Research Establishment in August, 1954. The study suggests a cyclonic circulation centered in the vicinity of Sable Island Bank but with the eastern part incompletely determined by the results. Calculated speed of drift varies from 0.11 to 0.15 knot. (Auth. abst.)

1456. Tabata, Susumu and George L. Pickard. 1957. THE PHYSICAL OCEANOGRAPHY OF BUTE INLET, BRITISH COLUMBIA. Jour. Fish. Res. Bd. of Canada, Vol. 14, No. 4, July, pp. 487-520.

Distribution of salinity, temperature, and oxygen on Bute Inlet based on twelve oceanographic surveys between the period August 1950 to July 1953 have been examined. The salinity structures of the shallow water during the various seasons can be classified under two main groups, one occurring at periods of small river runoff and the other at periods of large river runoff. In general, the surface salinity increases to seaward and with depth during all seasons. The surface water along the western shore is almost always observed to be less saline than along the eastern shore. The salinity of the deep water is 30.6 to 30.8 °/oo during both

periods. The seasonal fluctuation of salinity at the surface is well marked but below a depth of 60 feet no obvious cycle exists. The temperature distributions can be divided into two main groups, winter and summer. During both seasons the surface temperature generally increases to seaward. The temperature gradient in the upper layers during the winter is positive (increasing vertically downward) and during the summer is negative (decreasing vertically downward). From early spring to late autumn, a well-defined temperature minimum, in the middle and upper reaches of the inlet, is evident in the intermediate depths. The water in the greater depths has a temperature of 8.0 to 8.2° C. and remains almost unchanged throughout the seasons. A seasonal temperature variation is observed down to a depth of 150 feet and is in phase with the air temperature cycle, but below this it is less noticeable. Insolation and cold runoff water from the rivers are predominant factors in determining the fluctuation in the sea temperature. The concentration of dissolved oxygen is usually high in the surface layer. The water at the greater depth is not stagnant as evidenced by the oxygen concentration.

Values from 0.2 to 1.5 g./cm./sec. for the eddy coefficient of conductivity have been determined for the intermediate depths. (Auth. abst.)

1457. Légaré, Joseph Eugène Henry. 1957. THE QUALITATIVE AND QUANTITATIVE DISTRIBUTION OF PLANKTON IN THE STRAIT OF GEORGIA IN RELATION TO CERTAIN OCEANOGRAPHIC FACTORS. Jour. Fish. Res. Bd. of Canada, Vol. 14, No. 4, July, pp. 521-552.

In order to gain some picture of the seasonal variations in the plankton communities two cruises were made in the Strait of Georgia, one in June 1955, and the other in November 1955; 165 plankton collections were taken, also surface temperatures.

The correlation of these data have resulted in a number of conclusions concerning the distribution of plankton in the Strait of Georgia. The chief factor affecting the general distribution of plankton is the salinity gradient. The inflow of fresh water from the Fraser River forms zones of varying properties, and leads to the development of different plankton communities. The extent to which physical and chemical factors may determine the presence or absence of certain organisms from the zones described is discussed.

1458. Roussow, George, 1957. SOME CONSIDERATIONS CONCERNING STURGEON SPAWNING PERIODICITY. Jour. Fish. Res. Bd. of Canada, Vol. 14, No. 4, July, pp. 553-572.

In studying the age of sturgeons of the Danube (Romania), and of Acipenser fulvescens Rafinesque in the province of Quebec, I have observed a certain periodicity in their growth. This is seen not only in the age and length curves, but also in the cross-sections of the first ray of the pectoral fin which serve to determine the age of these fish. It is known that the growth of the body as a whole is in direct ratio to the growth of the bones, so the wide distance between two narrow (or winter) zones corresponds to the growth of the sturgeon during the summer. The growth retardations caused by the ripening of the gonads and the losses at the consecutive spawnings are visible in the ray sections in the form of "belts" of 2 to 7 narrower zones (or annuli). These indicate that the interval between spawning periods can vary from 4 to 7 years and more. It is noteworthy that spawning does not necessarily correspond with maturity, but may be delayed 2 or 3 years. (Auth. abst.)

1459. Vernon, E. H. 1957. MORPHOMETRIC COMPARISON OF THREE RACES OF KOKANEE (ONCORHYNCHUS NERKA) WITHIN A LARGE BRITISH COLUMBIA LAKE. Jour. Fish. Res. Bd. of Canada, Vol. 14, No. 4, pp. 573-598.

Samples of kokanee (land-locked sockeye salmon) drawn from the spawning runs to seven streams tributary to Kootenay Lake, British Columbia, were compared statistically for morphological variation between streams, between lake areas and between years. Kokanee within three major lake areas displayed great similarity in age, size, vertebral count, scale characters and development of secondary sex characters. Samples from a representative stream of each area difference in age at maturity, size, growth rate in the first year, vertebral count, scale row count, gill raker count, head length of males, growth form of caudal peduncle, eye diameter, development of secondary sex characters, ova per unit total weight, and commencement of spawning period. Variation between years in size and vertebral count did not obscure or alter the stability of differences between races over a period of four years. Kokanee straying to spawn in areas not of their natal origin were identified by age, size, vertebral count, scale character, and scale row count, and totalled less than three percent of 1,131 examined. Progeny of parents from the three races were propagated in a uniform environment from fertilization to six months after hatching. Parental differences in number of vertebrae were transmitted to offspring. Segregation during reproduction, due to strong homing tendencies, is considered the principal isolating mechanism leading to some genotypic divergence and considerable phenotypic variability. (Auth. abst.)

1460. Smith, Stanford H. 1957. EVOLUTION AND DISTRIBUTION OF THE COREGONIDS. Jour. Fish. Res. Bd. of Canada, Vol. 14, No. 4, July, pp. 599-604.

Increased knowledge of the morphological and physiological plasticity of the coregonids has minimized the significance of conflicting morphological data that have retarded the development of an evolutionary theory. Of the four phyletic lines recognized through worldwide studies, Coregonus originated in the lake and stream area of northwest Eurasia, Stenodus and Prosopium evolved in the rivers of Siberia and northwest America respectively, and Leucichthys became differentiated in the lake-studded area of northeast America. Isolation and range extension were facilitated by events of the

Pleistocene epoch. Inter-continental exchange most likely took place in the Bering Strait region. Representatives of each group in its area of origin are highly variable. Range extensions of each group are characterized by lesser morphological variability and at the extremes only one or two relatively stable species remain. (Auth. abst.)

1461. Pickard, G. L. and R. W. Trites. 1957. FRESH WATER TRANSPORT DETERMINATION FROM THE HEAT BUDGET WITH APPLICATIONS TO BRITISH COLUMBIA INLETS. Jour. Fish. Res. Bd. of Canada, Vol. 14, No. 4, July, pp. 605-616.

Fresh water entering British Columbia inlets moves seaward, mixing with and entraining salt water from below. A new method, based on a heat budget analysis, is developed to determine the mean seaward movement of the brackish layer. The method is also applied to gain information on the mixing process and to determine the depth from which salt water is entrained into the surface layer.

The values of mean transport calculated in this way are found to be in good agreement with those derived from other methods. The method offers some distinct advantages over direct methods for determining fresh water inflow and circulation, since results can be obtained quickly, with little effort, and without the necessity for anchoring a ship. (Auth. abst.)

1462. Black, Edgar C. 1957. ALTERATIONS IN THE BLOOD LEVEL OF LACTIC ACID IN CERTAIN SALMONOID FISHES FOLLOWING MUSCULAR ACTIVITY. II. LAKE TROUT, SALVELINUS NAMAYCUSH. Jour. Fish. Res. Bd. of Canada, Vol. 14, No. 4, July, pp. 645-649.

During the summer of 1954, $1\frac{1}{2}$-year-old, hatchery-raised lake trout, Salvelinus namaycush, were subjected to 15 minutes of severe muscular exercise at the trout hatchery at Summerland, B.C. Following exercise, fish were allowed to recover for various intervals up to 24 hours. Blood samples were taken and analyzed. The hemoglobin levels did not change significantly, the blood glucose increased significantly during the second hour of recovery. Except for dips at the 6th and 12th hours, this high level of glucose persisted to the end of 24 hours. The blood level of lactic acid increased sevenfold immediately following exercise and continued to increase during the first two hours of recovery. The lactic acid level declined rapidly between the 2nd and 6th hour. The initial low unexercised level was reached by the end of 24 hours. The hemoglobin and lactic acid changes were very similar to those noted for Kamloops trout, Salmo gairdneri. (Auth. abst.)

1463. Lindsey, C. C. 1957. POSSIBLE EFFECTS OF WATER DIVERSIONS ON FISH DISTRIBUTION IN BRITISH COLUMBIA. Jour. Fish. Res. Bd. of Canada, Vol. 14, No. 4, July, pp. 651-668.

The known distributions of freshwater fishes in drainages of the British Columbia mainland are summarized, including those of five species not previously recorded from the province. The continental divide forms a break in fish distribution; 35 of the 57 species on the Pacific slope in B.C. do not occur in the Mackenzie or Yukon River drainages of the province, and 11 of the 33 species in the latter area occur nowhere on the Pacific slope. Some proposed water diversions for hydroelectric development would cross the continental divide, and are likely to produce striking changes in fish distribution. A proposed Liard-Stikine diversion would probably introduce several species, including trout, into the upper Liard River, and several other species, including northern pike into the Stikine River. A proposed Peace-Fraser diversion would introduce into the Fraser River arctic grayling, and possibly several other species, including northern pike. Other proposed diversions are discussed, and their probable effects on fish distribution are listed. Any diversion introducing pike into waters supporting Pacific salmon is liable to be economically harmful, as pike are voracious fish-eaters. Pike are also vectors of Triaenophorus tape-worm, which has been found in Alaska to encyst in the flesh of Pacific salmon in a watershed inhabited by pike. (Auth. abst.)

1464. Miller, Richard B. 1957. HAVE THE GENETIC PATTERNS OF FISHES BEEN ALTERED BY INTRODUCTIONS OR BY SELECTIVE FISHING? Jour. Fish. Res. Bd. of Canada. Vol. 14, No. 6, November, pp. 797-806.

This paper is a review of some of the literature dealing with changes in freshwater fish populations following exploitation or after introduction of exotic species. The object of the review was to look for changes that could be attributed to alterations in the gene pools of the affected populations. Very little concrete evidence could be found, either because the investigations reviewed were not looking for genetic changes, or because such changes did not occur. Changes in some salmonids may be assigned to introgressive hybridization, particularly where rainbow and cutthroat trout have been put together on the Eastern Slopes. In many cases, however, exotics have apparently failed to contribute to the gene pool of the resident population, and most hybrids, when they occur, have been of low fertility.

Fishes have a remarkable ability to respond to changes in population density by altered growth rates and times of maturity. These changed characters are not necessarily due to genetic changes and may be explained by assuming that fishes are pre-adapted to a wide range of conditions. There is a rather speculative suggestion that angling may select less intelligent fish, leading to an upgrading in intelligence of the fish. The general conclusion is that in the light of the existing evidence, great caution must be used in attributing to man-induced changes in fish populations changes in the genetic pattern. (Auth. abst.)

1465. Black, Edgar C. 1957. ALTERATIONS IN THE BLOOD LEVEL OF LACTIC ACID IN CERTAIN SALMONOID FISHES FOLLOWING MUSCULAR ACTIVITY. III. SOCKEYE SALMON, ONCORHYNCHUS NERKA. Jour. Fish. Res. Bd. of Canada Vol. 14, No. 6, November, pp. 807-814.

The blood level of lactic acid in hatchery-raised sockeye salmon, Oncorhynchus nerka, was studied following 15 minutes of vigorous muscular activity. Yearling salmon acclimated and exercised in fresh water showed a sevenfold increase in blood lactic acid following activity, increasing still further during the first two hours of recovery, as in the Kamloops trout, Salmo gairdneri. Yearling salmon acclimated in sea water for two days and then exercised exhibited higher immediate increase in lactic acid and showed less fatigue. The sea water appeared to aid the yearling salmon in coping with fatigue products. However, two-year-old salmon that had been acclimated a year and a half in sea water showed the same change in lactic acid following exercise as the yearlings in fresh water. Five of 19 two-year-old salmon died following the exercise. (Auth. abst.)

1466. Hoar, W. S., M. H. A. Keenleyside, and R. G. Goodall. 1957. REACTIONS OF JUVENILE PACIFIC SALMON TO LIGHT. Jour. Fish. Res. Bd. of Canada, Vol. 14, No. 6, November, pp. 815-830.

When given a choice between light and dark areas, schools of chum or pink salmon fry remain in the light, sockeye fry prefer the dark and coho fry show no marked preference for either. Newly emerged sockeye fry are the most strongly photonegative, remaining mostly under stones. Older sockeye fry move more into the light. Sockeye and coho smolts stay in the dark more than sockeye and coho underyearlings. Territorial and "escape" behaviour by fish in the experimental apparatus may obscure these reactions to light. Soon after emerging from the gravel, pink fry swim near the surface under low light intensity and retreat to deeper water in brighter light. Older pink fry seem indifferent to changing light. Recently emerged chum salmon fry do not respond in this way to changing illumination, although older fry tend to swim closer to the surface. This difference between pink and chum salmon fry may be related to differences in schooling behaviour and alarm responses to the two species. (Auth. abst.)

1467. Bumpus, Dean F., Joseph Chase, C. Godfrey Day, David H. Frantz, Jr., David D. Ketchum and Robert G. Walden. 1957. A NEW TECHNIQUE FOR STUDYING NON-TIDAL DRIFT WITH RESULTS OF EXPERIMENTS OFF GAY HEAD, MASS., AND IN THE BAY OF FUNDY. Jour. Fish. Res. Bd. of Canada, Vol. 14, No. 6, November, pp. 931-944.

A transponding drift buoy has been developed to aid in the study of the horizontal motions of surface waters. Experiments to study the non-tidal drift off Martha's Vineyard, Mass., in June 1956, off Yarmouth, N. S., in October and November 1956, in Grand Manan Channel in October 1956, and off Saint John, N. B., in December 1956, are described and discussed. (Auth. abst.)

1468. Barber, F. G. 1957. THE EFFECT OF THE PREVAILING WINDS ON THE INSHORE WATER MASSES OF THE HECATE STRAIT REGION, B. C. Jour. Fish Res. Bd. of Canada, Vol. 14, No. 6, November, pp. 945-952.

Observations show that during the winter period of strong southeast winds, light surface waters accumulate along the coast, displacing the deeper waters offshore. During the summer period of weak southeast winds the accumulated surface waters move offshore allowing the return of the deep waters.

The winter accumulation is accompanied by a northwestward-flowing coastal current which appears to be continuous from California to the Gulf of Alaska. During the summer this current is small or absent.

It is noted that this seasonal change of water masses accounts for a major part of the observed sea level oscillation.

It is suggested that the winter displacement of deep waters and their return affect the movement of bottom fish of the region. (Auth. abst.)

1469. Alm, Gunnar. 1957. AVKASTNINGEN AV GÄDD- OCH ABBORRFISKET VID SVERIGES ÖSTERSJÖKUST UNDER ÅREN 1914 - 1955. (The yield of the pike and perch fisheries along the Baltic coasts of Sweden during the years 1914-1955.) Institute of Freshwater Research-Drottningholm. Report No. 38, pp. 5-69.

The brackish waters along the Swedish coast of the Baltic support important commercial fisheries for northern pike, yellow perch, and whitefish. Catch statistics for northern pike and yellow perch maintained since 1914 are analyzed to determine correlation between landing size and other factors such as fishing intensity, other fisheries, year-class strength, climatic conditions and those associated with favorable or unfavorable fishing conditions. Though no tangible correlation could be established between amount of fish caught and information collected on earlyness of spring conditions, water level, water flow in watercourses leading to the coast, and wind conditions, the fact that good years were characterized by relatively high and stable water levels, a good supply of water, and an early spring is obvious.

The capture of pike and the use of traps or fyke nets are forbidden during a certain part of the spring in several provinces; no such prohibitions exist for yellow perch. Catch statistics exhibit no correlation with these regulations. Also the size of the catch of spawning fish expressed as a percent of the annual catch is independent of the regulations. If designed to increase propagation, these regulations are superfluous; they, however, may prevent an excessive supply of fish on the market during this brief period.

1470. Lindroth, Arne. 1957. A STUDY OF THE WHITEFISH (COREGONUS) OF THE SUNDSVALL BAY DISTRICT. Institute of Freshwater Research-Drottningholm. Report No. 38, pp. 70-108.

By means of gillraker countings in more than 1,300 specimens, the Coregonus populations of the Sundsvall bay district in Sweden have been divided into two groups. The number of gillrakers proved

in a rearing experiment to be unmodified. It is thought to be genetically fixed and the two groups are, according to Svärdson, ranked as species, C. lavaretus L. and C. nasus Pallas. Both species inhabit the coast. C. lavaretus spawns in the large rivers, C. nasus by the coast.

Movements have been studied by the tagging of 1,300 adult fish, with a return of 29%. C. lavaretus, after spawning in the river, disperse along the coast mainly to the south. The maximum distance recorded was over 200 km. In midsummer the spawning migration sets in, probably all fish gathering every year in the home river. C. nasus populations along the coast are comparatively stationary, the populations of the species spawning close to the river mouth exhibit intermediate migratory habits. C. lavaretus spawns later than does C. nasus.

The offspring of the river spawning C. lavaretus leaves the river as eggs, fry and young (up to about 3 months old) probably in all cases passively migrating with the current. Such juvenile fish as are later found in the river, originate almost exclusively from whitefish populations in reservoirs and lakes upstream of that part of river accessible from the sea. The investigations have also been concerned with swimming speed and phototactic reactions in fry, and with growth and food in the young. Evidence is lacking as regards the genetical nature of the differences studied here in the habits of the two species: in migration, spawning and biology of the young. They may all be created by external influences. (Auth. summ.)

1471. Lindroth, Arne. 1957. BALTIC SALMON FLUCTUATIONS: A REPLY. Institute of Freshwater Research-Drottningholm. Report No. 38, pp. 109-130.

In a recent paper in this series Svärdson (1955) discusses the Baltic salmon fluctuations. Based upon correlation analyses between maximum ice cover in the Baltic sea area and a "salmon curve" or catch statistics from the Svartö weir in the river Lulu älv the paper deals with 1. a mathematically demonstrated connection between mild ice conditions and increased river catch in the 3rd summer thereafter, 2. a mathematically demonstrated connection between severe ice conditions and increased river catch in the 6th summer thereafter, and 3. the large-scale catch fluctuations.

The catch in the Svarto weir has been assumed representative for the northern Baltic. This is not the case however. In the mathematical treatment of the material due regard to its nature of "mixed connections of covariances" has not been payed. Those connections which are presumed to apply to secondary or yearly fluctuations are, therefore, no evidence of biological interrelations and the hydrological and biological arguments set forth for their interpretation are in essential details unverified and unlikely. The causes of the dominating primary or large-scale fluctuation, including the porpoise hypothesis, are not sufficiently analyzed and the importance of the porpoise hunting in the Danish sounds appears to have been over-estimated. (Auth. summ.)

1472. Lindström, Thorolf. 1957. SUR LES PLANCTONS CRUSTACÉS DE LA ZONE LITTORALE. Institute of Freshwater Research-Drottningholm. Report No. 38, pp. 131-153.

The abundance of plankton crustacea was studied in different parts of a shallow lake. The samples were mainly taken in August, but the annual cycle is illustrated by some observations. The littoral plankton was dominated by Bosmina and Polyphemus at stations where the total depth did not exceed three metres. The depth distribution of Bosmina is discussed. The concentration of Daphnia in the central parts of the lake, two metres below the surface, ceased where the total depth was less than three metres. No diurnal migration between deep and shallow parts of the lake was observed, but it is assumed that Bosmina moves between these parts in the course of the summer. The plankton abundance was highest in a bay where the water is exchanged very slowly, and was very low in a part where the flow through the lake passes a shallow section. Plankton abundance in affluents and outlets from different lakes is described. The relation between variance and mean is discussed.

The theory necessary to explain the plankton distribution in the littoral region was already developed in many respects fifty years ago and cannot be greatly elaborated without further experiments. It includes reactions to depth (light) and currents, transportation by water movements and possible dependence on plants and bottom as substratum; also competition between filter-feeding crustacea. Bosmina can partly avoid the competition from other species since its habitat includes streams and the most shallow parts of the littoral where other filter-feeding crustacea are rare. In northern Sweden Bosmina coregoni lives both in the littoral and the pelagial zone. (Auth. summ.)

1473. Nilsson, Nils-Arvid. 1957. ON THE FEEDING HABITS OF TROUT IN A STREAM OF NORTHERN SWEDEN. Institute of Freshwater Research-Drottningholm, Report No. 38, pp. 155-166.

The stomach contents of about 300 trout (Salmo trutta) adults and fry, from the River Rensjöån district in northern Jämtland were examined.

Differences were found in the food of lake-dwelling and river-dwelling trout, the lake-dwelling trout feeding mainly on fish and insects; the river-dwelling mainly on organic drift. Differences were found in the consumption of the food in the upper and in the lower course of the stream, the part played by the organic drift being more important in the upper course.

The fry were found to consume mainly food objects of smaller size than the adults, mostly planktonic crustaceans carried out by the current in the outflow of the lake. The behaviour mechanism regulating the feeding of the fry is supposed to be of a simpler, more basic type than that of the adult fish.

Burbot were found to share their main bottom food, larvae of Trichoptera, with the trout. They did not, however, consume drift food to any important extent. (Auth. summ.)

1474. Roos, Tage. 1957. STUDIES ON UP-STREAM MIGRATION IN ADULT STREAM-DWELLING INSECTS. I. Institute of Freshwater Research-Drottningholm, Report No. 38, pp. 167-193.

Preparatory experiments by net catching indicated a predominant upstream direction of flight in the females of lotic Trichoptera. A Malaise's bilateral insect trap was used for the main experiments. It was modified by means of a vertical partition wall in such a way that the catches from the two opposite halves of the trap were kept apart, thus enabling a determination as to whether the insects had kept an upstream or downstream direction along the river. By means of this trap a total of 5517 aquatic insect specimens were captured on two occasions of sampling. It was found that 70 - 80% of the females of lotic Trichoptera, Plecoptera, Ephemeroptera and Simuliidae flew in the upstream direction, when a feeble wind was blowing downstream. This behaviour was only to a lesser degree, if at all, to be found in the males. The material of rheo-indifferent and lenitic species gave no evidence as to a predominant flight direction in either sex; however, this material was inadequate.

There seems to be a co-ordination of multiple stimuli which guides the orientation of the females in relation to the water current. Among these there are some evidence of the wind being active. In a valley there are some given conditions for a predominance of local winds parallel to the course of the valley. Thus the valley topography has a deflecting effect upon the winds, which has been gauged as much as 135°, moreover the diurnal valley-wind pattern involves up-valley winds in the daytime, and down-valley winds at night. Finally the friction between the flowing water and the air causes micro-winds in the downstream direction. The investigated insects are to a high degree crepuscular and nocturnal flyers, and were found to press on against the wind.

The proved mass movement of females in the upstream direction is active and confined to specimens ready for oviposition. Thus the phenomenon can be termed migration. It serves as a mechanism which ensures a balance and the retention of the population in its habitat. Combined with the stream drift it forms the colonization cycle, involving a downstream distribution of the progeny through the action of the water current, counteracted by an upstream migration of the females for oviposition. The investigations were carried out on River Ammerån in the provins of Jämtland, Northern Sweden. (From. auth. summ.)

1475. Svärdson, Gunnar. 1957. THE COREGONID PROBLEM. VI. THE PALEARCTIC SPECIES AND THEIR INTERGRADES. Institute of Freshwater Research-Drottningholm. Report No. 38, pp. 267-310.

The speciation in the whitefish group has proceeded along the same lines as in other vertebrates. Sympatric speciation has not occurred. The species evolved during geographical isolation have later, when they could spread during the last glacial period, come to live sympatrically over vast areas of the Palearctic region.

The genus Coregonus is discussed. Seven species are redescribed for the Palearctic region. They comprise five whitefishes: pidschian, nasus, lavaretus, oxyrhynchus and peled and two ciscoes: albula and baunti. Experiments on the phenotypical variation of whitefishes are described. The capacity for environmental modification is profound in these fish. Only the number of gill-rakers is so far proved to be genetically based. Several species were artificially crossed and their F_1-hybrids have been proved to be fertile. The possibility of introgression in nature is thus experimentally established.

The whitefish and cisco populations of a great many Swedish lakes and localities on the Baltic Coast are presented. Some Norwegian populations are also described. Spontaneous introgression is found to be frequent. In environments with few ecological niches the process has gone very far, reaching replacement or complete fusion of populations. There is a general pattern of distribution in the Swedish rivers. Pidschian, oxyrhynchus and peled were the first invaders, already living in the Baltic Ice Lake, as did the ciscoes albula and baunti as well. Later on, probably first during the Litorina period, lavaretus and nasus entered the Baltic area and started a replacement process of the earlier arrivals. These, therefore, have mostly survived in the uppermost and most isolated lakes. All stages of the replacement can still be found in various lakes.

The European whitefish populations outside Scandinavia are reviewed and presented in Tables. The general pattern of the species and their mutual ousting and fusion in some localities is found to be similar to that of Scandinavia. (Auth. summ.)

1476. Svärdson, Gunnar. 1957. LAXEN OCH KLIMATET. (The salmon and the climate). Institute of Freshwater Research-Drottningholm. Report No. 38, pp. 357-384.

A critique of Lindroth's article (abstract No. 1471), which in turn is a critique of the author's paper of 1955 (abstract No. 453). These discussions are based on Svärdson's contention that a short-term population fluctuation of the Baltic salmon is correlated with climate in such a manner that peaks in the salmon catch of rivers occurred 2-3 years after mild winters and again 4-6 years after severe winters.

Lindroth argues that this short-term fluctuation is only an artifact, created by the long-term fluctuation which is also dependent on climate, and consequently he rejects the causes as suggested by Svärdson. (From. auth. summ.)

1477. Wallin, Olle. 1957. ON THE GROWTH STRUCTURE AND DEVELOPMENTAL PHYSIOLOGY OF THE SCALE OF FISHES. Institute of Freshwater Research-Drottningholm. Report No. 38, pp. 385-447.

The extremely numerous investigations into the

development of the scales of fishes which have been published have not resulted in a greater measure in widened information on the subject. On the contrary, the results of examinations, also those carried out at the same time, have not agreed even in the main points. This can partly depend on technical difficulties, inherent with the object, partly on deficient general information about the way in which the extracellular components of the connective tissue are formed, and partly on the great differences existing between the different species examined. This last point implies that it is not admissible to assume the applicability of results obtained from one type of scales to every other type.

The problem of the origin of the striae which is of greatest importance for practical studies has given rise to widely divergent hypotheses. These have in all cases been based upon general, non-specific histological stainings, while practically no attempts have been made to approach the problem by an experimental analysis.

In this investigation specific histochemical methods have been applied to the study of the scales of fishes for the first time. By this procedure it has been possible to elucidate the presence of acid mucopolysaccharides in the osseous layer and their connection with the calcification. The zone of growth of the scale and the scale-building cells have been identified. In this way it has been possible to follow the development of a stria from the germ stage to the stage of full development. The discovery of the great importance of the calcification for the morphological configuration of the stria was surprising. On the basis of these facts together with the experimental results both the mechanism of the formation of the striae and the development of the "winter ring" have been drawn up. The striae are the results of a compression of the scale-forming assemblage of cells between the dermis in the scale pocket and the calcified scale. The compression is due to the increase in volume of the cells on their transformation into the active stage. The accumulated pressure induces the formation of a fold in which the stria is formed. The closely set striae of the "winter ring" are formed at the resumption of growth in spring and as a result of the small width of the osseoid zone, since the distance between the striae is, within certain limits, proportionate to this width. Thus a determination of the width of the zone of growth makes it possible roughly to decide whether or not an individual is in a state of growth.

Several earlier authors are of the opinion that the fibrillary plate and the osseous zone have different origins. In the present investigation it has, however, been possible to demonstrate that osseous layer as well as fibrillary plate are extracellular formations which in addition merge into one and into the same germ structure at the periphery of the scale. The absence of metachromatic substances renders the fibrillary plate unique among calcified tissues. By the absence of alkaline phosphatase and glycogen in the scale-forming cells also the scale as a whole exhibits a simplified type of the formation of bone.

The main interest has been directed towards the formation of the striae and the development of the scale. In this connection the experimental study of the formation of the striae has yielded certain results of a more general physiological bearing. Strong arguments have been advanced for the opinion that the fishes are unable to synthesize their entire requirement of vitamin C. Also vitamin D is necessary in order to prevent damages in the exoskeleton of the fish. An examination of the serum calcium indicates a strict governing of the metabolism of calcium in the fish. (Auth. summ.)

1478. Brooks, Merle Eugene. 1957. ECOLOGY OF THE CLADOCERA OF KANSAS. Dissertation Abstracts, Vol. XVII, No. 10, p. 2335.

This thesis is a study of the ecological characteristics of the Cladocera of Kansas. Qualitative net samples and ecological data were collected from 301 fresh-water habitats over the state of Kansas. At least three bodies of water from each county of the state, except for a few far-western counties, were utilized as collecting areas. The areas included 113 roadside ditches, 95 ponds, 42 creeks, 26 sloughs, 16 lakes, five backwaters, two salt marshes, and two strip-pits. The purposes of the study were to contribute further to the knowledge of cladoceran taxonomy, geographical distribution, species associations, and significance of such ecological factors as temperature, hydrogen-ion concentration, free carbon dioxide, and dissolved oxygen. Forty-one cladoceran species were identified, 23 of which were new for the state. Twenty species were collected from lakes, 28 from roadside ditches, 30 from ponds, 23 from creeks, 15 from sloughs, 10 from strip-pits, five from backwaters, and one from salt marshes.

With respect to environmental factors, the highest water temperature was 39°C; the lowest 2°C. The optimum temperature range for the cladocerans of Kansas appears to lie between 22° and 32° C. The hydrogen-ion concentration ranged from 5.5 to 8.5, the environmental optimum being pH 6.8 to 7.8. Free carbon dioxide varied from absent to 44 ppm. When the free CO_2 reached a concentration above 4 ppm, a decrease in the number of species occurred. Dissolved oxygen varied from 0 to 22 ppm. When the dissolved oxygen attained and exceeded 12 ppm, a rapid decrease in the number of species occurred.

Interspecies associations and competition may not be important factors in limiting the distribution of cladocerans, as each of the 41 species was able to live in association with two or more other species. Eight species were found to be associated with 20 or more species in various habitats, while 25 species were found to be associated with 10 or more species. (Auth. abst.)

1479. Calhoon, Thomas Bruce. 1957. ADRENAL CORTICAL EXTRACT AND CARRYING AGENTS ON THE METABOLISM OF POIKILOTHERMS. Dissertation Abstracts, Vol. XVII, No. 11, p. 2655.

Studies were made of the effects of adrenal cortical extract on the oxygen consumption and mean body weights of two groups of cold-blooded animals

(Carassius auratus and Rana pipiens) subjected to varying degrees of stress. Sesame oil (a common carrying agent for fat soluble substances), given intramuscularly or subcutaneously, was used as the stressing agent.

The oxygen consumption determinations were carried out using two methods. One method, the Winkler, was used in the studies involving the effects of large doses of sesame oil, alone and together with adrenal cortical extract, on the oxygen consumption of goldfish. The other method, the volumetric, was used in the experiments treating of the effects of adrenal cortical extract on the oxygen consumption of normal frogs. Both the Winkler and the volumetric methods were used in the studies on the effects of small doses of sesame oil, alone and together with adrenal cortical extract, on the oxygen consumption of goldfish.

The volumetric method devised for these investigations consists in making determinations of volume changes of a closed system maintained at constant pressure. Any decrease in gaseous pressure (oxygen consumed) is compensated by a decrease in total volume. The decrease in volume is measured by an appropriate movement of pistons having known displacements.

Results of the various studies are given. (From auth. abst.)

1480. Ekberg, Donald Roy. 1957. RESPIRATION IN TISSUES OF GOLDFISH ADAPTED TO WARM AND COLD. Dissertation Abstracts, Vol. XVII, No. 11, p. 2659.

The oxygen consumption of brain, liver, and gills excised from goldfish (Carassius auratus) adapted to 30° C. or 10° C. was measured at various temperatures between 10° C. and 30° C. by means of the Warburg technique. Rate-temperature curves revealed no significant differences between brain homogenates from 10° C. or 30° C. adapted fish. Similar non-significant results were obtained with liver homogenates. However, significant differences were found between gills (either whole or homogenized) from fish adapted to 10° C. or 30° C.

Comparisons of the slopes of the gill rate-temperature curves revealed no apparent differences. However, it was found that gill oxygen consumption was greater during the summer months than during the winter months. This seasonal variation was independent of the temperature of adaptation.

Inhibition of oxygen consumption (measured at 26 ° C.) by 10^{-3} M. cyanide or 5.4×10^{-4} M. iodoacetate disclosed that gills from 30° C. adapted fish were significantly more resistant to cyanide and significantly less resistant to iodoacetate than were gills from fish adapted to 10° C. These results suggest that the cytochrome system has become less sensitive to cyanide poisoning or that an alternate pathway less sensitive to cyanide than the cytochrome system has increased in activity in gills from fish adapted to 30° C., and that the hexosemonophosphate shunt is more active in gills from 10° C. adapted fish. (Auth. abst.)

1481. Sette, Oscar Elton. 1957. BIOLOGY OF THE ATLANTIC MACKEREL (SCOMBER SCOMBRUS) OF NORTH AMERICA. PART I--EARLY LIFE HISTORY. PART II--MIGRATIONS AND HABITS. Dissertation Abstracts, Vol. XVII, No. 11, p. 2718.

Early Life History--After six seasons of plankton towing to explore the distribution of mackerel spawning in time and space along the United States Atlantic Coast, and to develop quantitative methods, an intensive plankton-towing program in 1932 furnished 400 hauls with related oceanographic and meteorological observations. These provided the quantitative materials for study.

The Atlantic mackerel spawns mainly 10 to 30 miles offshore from Chesapeake Bay to Newfoundland. About nine-tenths of it takes place south of Cape Cod. The model temperature for spawning is 11°C. The pelagic eggs are suspended in the upper 15 to 25 meters of water. Hatching in about one week, larvae grow logarithmically from 3 mm. to 50 mm. in 66 days when they attain the typical mackerel-form shape and assume the schooling habit.

In 1932, an estimated 64,000 billion eggs were produced south of Cape Cod by an estimated 100-million spawning population. That year abnormal northeasterly winds drifted one concentration of eggs southwestward from off northern New Jersey to off Delaware Bay and another from off southern New Jersey to off the Chesapeake Capes. A subsequent wind reversal returned the larvae from both groups northeastward to northern New Jersey by their 9-mm. stage of growth.

Contrary to prevalent theory, mortality was fairly uniform at 10 to 14 per cent per day throughout pelagic existence, except during the 8-10 mm. stage when there was a 30 to 45 per-cent-per-day decline in numbers per unit tow. Survival through planktonic existence (egg to 50 mm.) was in the order of 1 to 10 fish per million eggs spawned. From the scarcity of fish from this spawning season in the adult population of subsequent years it is known that this is an abnormally low survival rate. The low survival is ascribed to the abnormal southerly drift, coupled with a general scarcity of plankton in the spring of 1932.

Migrations and Habits--Mackerel are caught commercially over the inner part of the American Atlantic continental shelf, with the smaller and younger sizes usually closer to shore than the adults. They appear in April off the Virginia Capes and by July extend from southern New England to the Gaspe Coast.

During the fishing season mackerel tend to school by size. From livecar observations this appears related to size-connected swimming ability, depending on the body-surface to body-weight ratio. The schools are confined to the warm layer above the thermocline which averages from 20 meters deep inshore to 50 meters offshore.

From incidental winter catch records it was deduced that mackerel then occupied a band of relatively warm water flanking the continental edge from Cape Hatteras to Georges Bank, probably keeping to mid-depths and finding feed irregularly.

From the size composition in thousands of samples

taken daily during each fishing season from 1926 to 1935, two main migrating elements were recognized. A southern contingent from the continental edge approached the middle Atlantic coasts in early April and occupied the Gulf of Maine during summer. A northern contingent approached Massachusetts in late May and occupied the Gulf of St. Lawrence in the summertime. Both contingents disappeared by December at locations north of their respective spring appearances, probably descending to deeper waters when the thermocline was dissipated by autumn cooling and mixing. The essential features of this migratory pattern, as deduced from size-composition, were corroborated by tagging experiments.

1482. Nelson, Daniel J. 1957. THE STANDING CROP AND PRODUCTIVITY OF A ROCK OUTCROP IN THE MIDDLE OCONEE RIVER, GEORGIA. Dissertation Abstracts, Vol. XVII, No. 12, December, p. 2774.

A community of organisms on a rock outcrop in the Middle Oconee River was studied to determine the seasonal changes in the trophic structure, the net productivity by each trophic component, and the source of detritus in river water. Samples were secured with a Surber-type sampler made with number seven, silk, bolting cloth which covered 100 cm^2. Samples were sorted under the low power of a binocular microscope.

Podostemum ceratophyllum, with its attached aufwuchs, was the important primary consumer component of the community. It provided a place of attachment and shelter for a rheophilus fauna consisting largely of insects. The primary consumers were divided according to the feeding habits of the organisms into herbivores, detritus feeders, herb and detritus feeders, and filter feeders. River discharge was a significant and variable aspect of the study area. High, turbulent flows washed both animal and plant material downstream. Moderate river discharges were conducive to growth of Podostemum and animals. Low discharges exposed large areas of the rock outcrop to desiccation.

Allochthonous detritus served as an important food source for detritus and filter feeding organisms. The bottom sediments in the stream acted as a trap and reservoir for waterlogged allochthonous material. Comminution of detritus by the shifting sand bottom resulted in a continual addition of particulate organic material to the river water. A higher and more variable quantity of particulate detritus was present in the river water from May to September than from October to April. Summer thunderstorms with a rapid run-off, causing a rapid river rise, were considered responsible for the increased variability.

Carnivore-primary consumer weight and number ratios reached a seasonal low in June, followed by a gradual increase in both. The trend of increasing ratios was disrupted by high water in September, after which the ratios decreased until the end of November. Number ratios increased in December and weight ratios increased until February. Both ratios decreased after these winter maxima.

The estimates of net annual productivity were 930.276 gm/m^2 by the primary producers, 29.678 gm/m^2 by primary consumers, and 4.318 gm/m^2 by carnivores. The efficiency of energy transfer to the primary producer level based on an annual insolation of 156,924 gm cal/cm^2 was 0.25 per cent. Herbivores had a trophic efficiency of 1.43 per cent and carnivores 14.55 per cent. It was suggested that losses of organisms downstream during periods of high water accounted for the low efficiency at the primary consumer level. Annual turnovers were estimated as follows: Podostemum 2.6, herbivores 9.97, filter feeders 5.77, and carnivores 7.01. It was estimated that 61.05 per cent of the net annual productivity by primary consumers came from allochthonous sources. The primary productivity by phytoplankton in the river water was insignificant as indicated by very slight diurnal changes in the dissolved oxygen content of the water. (Auth. abst.)

1483. Bamforth, Stuart Shoosmith. 1957. ECOLOGICAL STUDIES ON THE PLANKTONIC PROTOZOA OF A SMALL ARTIFICIAL POND. Dissertation Abstracts, Vol. XVII, No. 12, p. 3130.

A one-year survey was conducted on a small artificial pond to determine environmental relationships of planktonic protozoa to physical and inorganic chemical factors.

Collections were made at 9:00 A.M., Eastern Standard Time, every other day. Planktonic samples were taken from the surface and bottom, and sunlight intensity and temperature measured. Chemical analyses included alkalinity, carbon dioxide, chloride, dissolved oxygen, nitrate, nitrite, ammonia, phosphate, pH, hardness and turbidity. Bacteria counts were made microscopically and protozoa were handled by the Sedgwick-Rafter method.

Most chemical factors followed the same trend as temperature. However, dissolved oxygen, pH, and nitrate followed the converse trend and were highest in winter and spring. Conditions in summer were characterized by increased amounts of carbon dioxide, nitrite, ammonia, phosphate and a decrease in dissolved oxygen and pH. Variations in phosphate paralleled those of bacteria and turbidity, and phosphate production indicated conditions where processes of decay were greater than those of resynthesis.

The order of appearance of phytoplankton may have been influenced by the abundance of growth factors coupled with varying amounts of dissolved substances: Cryptomonas appeared in autumn and early summer; chrysomonads and Chlamydomonas in winter; Glenodinium, Pyramimonas and diatoms in spring; and euglenoids in summer.

Phosphate appeared to influence the range in which many phytoplanktons live: chrysomonads were not found when the water contained more than .02 ppm of phosphate, whereas cryptomonads and diatoms increased at this concentration, and euglenoids were abundant at several times this concentration. Within each phosphate range, nitrogen and sometimes carbon sources appeared to exercise

more immediate effects. Supply of organic nutrients appeared to influence euglenoid numbers.

Sunlight and temperature are important factors for some phytoplankton. Increases in light and temperature were favorable for diatoms but unfavorable for Glenodinium cinctum and Trachelomonas hispida.

Three distinct populations of ciliates appeared: a winter population of Urotricha, which preyed on chrysomonads; a spring population of Oxytrichous hypotrichs and Phascolodon vorticella, which preyed on phytomonads; and a summer population of large Holophryidae, which showed a direct correlation with phosphate and turbidity (considered indications of bacteria and detritus increases. Rotifers, predominantly of the detritus-feeding type, also showed the same correlation as Holophrydae, and both groups were considered bacteria-detritus feeders. These observations suggest that the nature and amount of food is the controlling factor for ciliates.

Sudden and profound changes can and do occur in a body of water in a short period of time. Many planktonts live perilously close to minimal conditions and slight environmental changes can promote rapid growth, reduction, or subsidence of populations. Many factors affect populations and different factors are limiting at different times. This survey emphasizes the need of detailed studies of limited natural environments over a long period of time as a prerequisite to understanding the ecological relationships of planktonic organisms, and that protozoan habitats must be defined more precisely to be meaningful. (Auth. abst.)

1484. Merkel, Terrence J. (Georgia Game and Fish Comm., Clayton.) FOOD HABITS OF THE KING SALMON, ONCORHYNCHUS TSHAWYTSCHA (WALBAUM), IN THE VICINITY OF SAN FRANCISCO, CALIFORNIA. Calif. Fish and Game. 43(4): 249-270. 4 fig. 1957.

The stomach contents of 1,004 troll-caught king salmon from the vicinity of San Francisco Bay were analyzed. These salmon were caught between October 6, 1954, and October 5, 1955, and fish, crustaceans, cephalopods, and polychaete worms comprised their entire diet. Six items constituted 92.5 percent of the total food consumption. These items were northern anchovy (Engraulis mordax), 29.1 percent; rockfishes (Sebastodes spp.), 22.5 percent; euphausiids, 14.9 percent; Pacific herring (Clupea pallasi), 12.7 percent; squid, 9.3 percent; and crab megalops, 4.0 percent. Seasonal changes in feeding habits were noted and maturing king salmon taken inside San Francusco Bay apparently had almost ceased feeding. The food habits of different sizes of king salmon were found to be generally similar. -- T. J. Merkel.

1485. Clemens, Harold B. 1957. FISHES COLLECTED IN THE TROPICAL EASTERN PACIFIC, 1954. California Department of Fish and Game. California Fish and Game, Vol. 43, No. 4, October, pp. 299-307.

This paper is concerned with marine fishes of Central and South America and the Galapagos Islands collected incidental to tuna tagging operations conducted from the tuna clipper M. V. Mayflower during the period February 13 to June 9, 1954. In all, some 5,000 specimens were preserved frozen or in formalin and brought to the California State Fisheries Laboratory for identification and disposition. From these, 62 families containing 137 species in 115 genera have been identified. The species are listed. (From auth. intro.)

1486. Norris, Kenneth S. 1957. SECOND RECORD OF THE GREEN STURGEON IN SOUTHERN CALIFORNIA. California Fish and Game, Vol. 43, No. 4, October, p. 317.

On April 27, 1957, a green sturgeon, Acipenser medirostris Ayres, 744 millimeters in total length and weighing 3 pounds 14 ounces was taken in 18 feet of water just north of Point Vicente, Los Angeles County, California. The green sturgeon has previously been reported south of Monterey on one occasion. In this instance a 7 1/4-pound specimen was taken between Huntington Beach and Newport Beach in a bait net set in 10 fathoms of water.

1487. MacLulich, D. A. 1957. THE PLACE OF CHANCE IN POPULATION PROCESSES. The Journal of Wildlife Management, Vol. 21, No. 3, July, pp. 293-299.

It is impossible to consider adequately the role of chance in living populations without entering into discussion of all aspects of ecology. However, the direct effects of chance in respect to population have been reviewed.

The ecologist starts with biology and environment, i.e., organized observations of animals and their relations among themselves and with their environment, including other animals. He includes chance or random numbers as a nondescript package of remainders, variations, and events inexplicable or unmeasurable by the existing level of scientific knowledge and techniques. He uses inductive reasoning, whereas the statistician using a deductive approach (Solomon, 1949) tends to start with randomness and bring in only such biological knowledge as appears unavoidable. The two viewpoints could come together by the ecologist's acquiring and interpreting full biological knowledge of the situation and the statistician using the same full information in his computations. At this point the role left to chance would in most cases be small.

Unless wildlife data can be proven to be accurate enough to justify it, detailed statistical interpretations of small apparent fluctuations should not be emphasized.

Equations exist that allow for necessary chance encounters with its host as a step in the life history of a parasite.

Random numbers do not explain wildlife population history, and resemblance to random numbers in a population time series has no significance.

1488. Zippin, Calvin 1958. THE REMOVAL METHOD OF POPULATION ESTIMATION. Jour.

of Wildlife Management, Vol. 22, No. 1, January, pp. 82-90.

The assumptions underlying the removal method of population estimation were reviewed and a graphical method of estimation (the multinomial method) was recommended and described.

If the assumptions of the method hold, the precision of a population estimate is primarily dependent on the proportion of the population captured, or the total number of units of trapping effort employed in the program, and relatively little on the number of trappings. Relatively large proportions must be captured in order to obtain precise estimates of population size.

Specific effects of failures in the basic assumptions, such as a decrease in the average probability of capture from one trapping to the next, and immigration into the trapping area during the trapping program, were described. Where the assumptions of both the removal and recapture methods of population estimation are met, the recapture method would be expected to give more precise results.

The assumption of a constant probability of capture was studied using data from the North American Census of Small Mammals. To compensate for an indicated departure from this assumption under actual trapping conditions, the standard-error formula for the estimate of population size should be inflated. An inflation factor of 1.2 was suggested for the data studied. (Auth. summ.)

1489. Cairns, John, Jr. and Arthur Scheier. 1957. THE EFFECTS OF TEMPERATURE AND HARDNESS OF WATER UPON THE TOXICITY OF ZINC TO THE COMMON BLUEGILL (LEPOMIS MACROCHIRUS RAF) Notulae Naturae of The Academy of Natural Sciences of Philadelphia, Number 299, June 21, pp. 1-12.

Literature dealing with the toxicity of zinc to fish is discussed. Variation in the physical and chemical environment was kept to a minimum throughout the test period. The concentration of zinc which resulted in 50 per cent survival in 96 hours was determined. In soft water this was 2.86 to 3.78 p.p.m. at 18°C, and 1.93 to 3.63 p.p.m. at 30° C. In hard water this was 10.13 to 12.5 p.p.m. at 18°C, and 10.15 to 12.3 p.p.m. at 30°C. The hardness of the dilution water appears more likely to affect the tolerance of bluegills to zinc than differences in temperature. (Auth. summ.)

1490. Northcote, T. G. 1958. EFFECT OF PHOTOPERIODISM ON RESPONSE OF JUVENILE TROUT TO WATER CURRENTS. Nature, Vol. 181, No. 4618, May, pp. 1283-1284.

Rainbow trout fingerlings, hatched in May, were acclimatized to temperature in six holding tanks during October, two tanks each held thermostatically at 10°, 15°, and 20° C. One tank at each temperature received 8 hours of illumination alternating with 16 hours of darkness, while the other three tanks received 16 hours of light and 8 hours of darkness. Illumination varied between 2.4 and 4.8 foot-candles at the water surface. Response of trout to water current was tested in a continuous flume which maintained the acclimation temperatures. Trout ranged from 55 to 125 mm. in fork length. All tests were made during "day" periods of the fish being tested.

Those held at a 16-hour day-length exhibited a strong negative reaction to current, particularly at low holding temperature, and in only one lot (at 15° C.) was an appreciable amount of upstream swimming observed. In their strong negative response to current, long day-length trout cycled actively, heading downstream in the current, often at a velocity higher than that in the flume. At low holding temperature, downstream swimming velocities two to three times that of maximum water velocity were recorded. Group response was observed, but was not of a permanent nature. On the other hand, 8-hour day-length fingerlings showed virtually no downstream cycling but moved upstream against the current, especially at low holding temperature (10°C.). Fish at both day-lengths showed less cyclic movement, either upstream or downstream, at the high holding temperature (20°) and tended to maintain position in the current.

1491. Shaw, Evelyn. 1957. POTENTIALLY SIMPLE TECHNIQUE FOR REARING "GERM-FREE" FISH. Science, Vol. 125, No. 3255, May, pp. 987-988.

Dipping eggs of Tilapia macrocephala into 0.04-percent formaldehyde-aquarium water solution for 10 minutes resulted in germ-free fry. Since this problem was not related to the experiments being conducted, it was not pursued further but the observations suggest that germ-free Tilapia could be raised.

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